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2004 Summary of the Weir Herring Tagging Project, with an Update of the HSC/PRC/DFO Herring Tagging Program.

Résumé pour 2004 du Projet d'étiquetage du hareng capturé dans des bordigues et mise à jour du Programme d'étiquetage du hareng HSC/CRPP/MPO.

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ABSTRACT

From 1998 to 2002, the Pelagics Research Council/Herring Science Council, in partnership with Fisheries and Oceans Canada, tagged herring on spawning grounds and on the major Nova Scotia overwintering grounds. A total of 92 647 herring were tagged. Although this project has concluded, tags continue to be returned. The information on tags returned in 2003 is presented in this paper.

In August, 2002, the Fundy Weir Fishermen Association, in partnership with the New Brunswick Department of Agriculture, Fisheries and Aquaculture, Grand Manan Fishermen's Association, Connors Brothers Ltd. and Fisheries and Oceans Canada, initiated a second tagging program to be conducted over a three year period. The purpose of this project is to investigate the in season movement and migration of herring in the Bay of Fundy with the long term goal of providing information on stock structure. Since the start of this project a total of 46 330 herring have been tagged (32 570 in 2003) and 1 379 tags have been recovered. The majority of recoveries have been from close to the site of application. However, there were also some recoveries from fish caught on the spawning grounds of Scots Bay and German Bank off Coastal Nova Scotia, Ipswich Bay off Coastal USA and from mixed aggregations off the Long Island Shore. The results to date are summarized.

RÉSUMÉ

De 1998 à 2002, le Conseil des recherches sur les pêches pélagiques et le Herring Science Council, en partenariat avec Pêches et Océans Canada, ont effectué une série de sorties d'étiquetage du hareng dans ses frayères et ses principales aires d'hivernage dans les eaux de la Nouvelle-Écosse. Au total, 92 647 harengs ont été étiquetés. Quoique ce projet ait pris fin, des étiquettes continuent d'être retournées. Le présent document est un résumé des renseignements tirées de celles retournées en 2003.

En août 2002, la Fundy Weir Fishermen Association, en partenariat avec le ministère de l'Agriculture, des Pêches et de l'Aquaculture du Nouveau-Brunswick, la Grand Manan Fishermen's Association, Connors Brothers Ltd. et Pêches et Océans Canada, a lancé un deuxième programme d'étiquetage du hareng, qui s'échelonnera sur trois ans. L'objectif de ce projet est d'établir les déplacements saisonniers et les migrations du hareng dans la baie de Fundy, le but à long terme étant de recueillir de l'information sur la structure des stocks. Depuis le début du projet, un total de 46 330 hareng ont été étiquetés (dont 32 570 en 2003) et 1 379 étiquettes retournées. La plupart de celles-ci ont été récupérées près du point où elles ont été posées, mais quelques-unes ont été récupérées dans les frayères de la baie Scots et du banc German, situé au large de la Nouvelle-Écosse, et de la baie Ipswich, aux États-Unis, ainsi que dans des bancs mélangés présents au large de la côte de l'île Long, située aussi aux États-Unis. Les résultats obtenus jusqu'à maintenant sont résumés dans le présent document.

1. Introduction

The herring fishery in the Scotia-Fundy area has a landed value of $17,788,000 (Canada, 2004) and contributes greatly to the economy and the culture of the Maritimes. Management of the industry has been partly based on tagging studies conducted almost thirty years ago. In 1998 it was recognized that many significant changes in the fishery and the environment have occurred since these studies, and there was a need for the stock structure and movement patterns to be re-evaluated (Mouland *et al.*, 2003). To this end, two large scale tagging projects have been undertaken. The Pelagics Research Council/Herring Science Council, in collaboration with Fisheries and Oceans Canada, conducted a tagging project from August 1998 to January 2002. In the fall of 2002, the Fundy Weir Fishermen Association, in partnership with the New Brunswick Department of Agriculture, Fisheries and Aquaculture, Connors Brothers Ltd., Grand Manan Fishermen's Association and Fisheries and Oceans Canada (DFO), initiated a second herring tagging study focusing on herring landed in the weir fishery for the purpose of investigating stock structure, fish migration and movement patterns (Mouland *et al.*, 2003). This document is a summary of tag returns from the herring weir and PRC/HSC programs, with recommendations for the next year of the weir herring tagging program.

2. PRC/HSC Tagging Project (1998-2002): Update

2.1 Introduction

In 1998, the Pelagics Research Council (PRC), in partnership with the Science Branch of DFO, initiated an extensive herring tagging program which continued under the auspices of the Herring Science Council (HSC) and DFO until January, 2002 (Mouland *et al.*, 2003). The purpose of this project was to re-evaluate issues relating to herring stock structure and to study herring migration patterns (Paul, 1999; Waters *et al.*, 2000). Herring were tagged on major spawning grounds and in overwintering areas. In addition, as part of this project, some preliminary experiments were conducted on herring from New Brunswick weirs. Although this tagging program has now concluded, tags are still being returned.

2.2 Results

A total of 92 647 herring were tagged throughout the Maritimes in various locations (see Mouland *et al.*, 2003). There have been 891 recoveries from this tagging thus far. The calculated return rate is just below 1%.

A total of fifteen additional tags were returned during the 2003 fishing season (Table 1). Fourteen of the recoveries were from herring that were tagged from Chebucto Head, just off Halifax, Nova Scotia. These fish were found in two spawning groups (five on German Bank, one in Scots Bay) and two summer feeding aggregations (two in NB Weirs, two on Moore's Ledge). One recovery was from a fish that was both tagged and recovered on German Bank.

These tag returns, ranging from 527 to 1 017 days at sea, demonstrate that herring survive the initial tagging experience and can live for long periods of time afterwards. There are fifteen tag returns from this program from herring that were at large for over two years, including one that was recovered after 1 017 days (over 2 years and 9 months).

3. Weir Tagging Project: Update

3.1 Introduction and Background

The herring weir fishery in the Bay of Fundy dates from before the European settlement of North America. Local bands of indigenous Canadians (Passamaquody and Mi'kmaq) used weirs to catch fish for subsistence (Grand Manan Tourist Association, 2003). Today the weir fishery is a thriving commercial fishery that supplies herring to the largest sardine producer in the world and provides significant primary and secondary employment in the Charlotte County area. This fishery plays an important role in the rural economy and is an integral part of the history of New Brunswick. Sustainability of this resource depends on effective management that is based on sound scientific evidence.

Recent changes in fishing activity, including the resurgence of a fishery on George's Bank, the decline in the number of active weirs in the Bay of Fundy and the increase in the number of aquaculture sites, have prompted scientists and industry to re-evaluate issues relating to the Bay of Fundy herring stocks (Mouland *et al.*, 2003). In 2002, a tagging program was implemented to document the stock structure and movement patterns of herring from the weir fishery for both management and scientific purposes.

The weir fishery is a passive fishery that is not subject to any catch limits but is restricted by resource and site availability as well as market (Canada, 1999). Management of the herring weir fishery has been partly based on previous tagging studies from almost 30 years ago. Many significant changes in the fishery and the environment have occurred over this time period and thus movement and migration patterns needed to be re-evaluated.

Patterns of movement and migration of herring within the Bay of Fundy are not well documented and are based largely on anecdotal information from fishers (Mouland *et al.*, 2003). Intensive tagging is being conducted to allow for an examination of the fine scale intra-seasonal movement of fish within the Bay of Fundy. This information can be used to investigate migration routes, intra-seasonal distribution frequency, and the degree to which the same schools of herring contribute to catch in different areas of the Bay. According to the historical catch data from 1999-2002 herring move into weirs around Bliss, Deer and Campobello Islands in May and then spread toward Grand Manan in June. Finally they enter the weirs off the Wolves in July (Mouland *et al.*, 2003). These catch data are, however, dependent largely on market. Tagging provides an opportunity to verify these observations, as well as providing information on larger scale movements.

Improving information on stock structure for U.S. and Canadian transboundary science and management purposes is an objective of this project. Currently, juvenile herring caught in New Brunswick weirs are considered to originate from U.S. waters (NAFO areas 5Y and 5Z) and are therefore not considered part of the 4VWX (Canadian) herring Total Allowable Catch (TAC) (Power *et al.*, 2002). It has been suggested, that a

proportion of these fish may also originate from the Bay of Fundy/Southwest Nova Scotia stocks. Tag returns from fisheries in U.S. and Canadian waters are being used to test this hypothesis.

Finally, an analysis of the mortality due to tagging and tag retention is the third objective of this program. Data collected as part of this study will be used to examine mortality rates due to tagging. In 2004, some double tagging will be conducted to determine how well the tags are retained by the fish. This is an academic objective that will provide vital information necessary for the interpretation of the data collected.

3.2 Material and Methods

Herring were tagged with individually numbered T-bar anchor tags in the Bay of Fundy during the fishing season (which occurred from May through to October). A herring carrier provided transportation of field workers to and from the weir(s) and provided the platform for tagging. The fish were loosely seined up to the side of the boat and placed in a holding tank using a long-handled dip net. It was important to ensure that fish were in good condition when bringing them aboard the vessel. As fishing operations continued, herring were tagged and placed into a release tank. The release tank was equipped with a funnel allowing the herring to be released below the surface of the water. This method successfully minimized the amount of time the fish spent out of water, avoided predation from gulls, and excessive handling. Herring were generally released a short distance away from the weir to avoid fish immediately re-entering the weir. A random sample of 100-200 fish was collected from each tagging event to collect data on the size, sex, age and maturity of the particular group of fish that were tagged. The methodology for tagging herring from weirs is summarized in Mouland *et al.* (2003) and Paul, (1999). The maturity stage and sex of herring collected for detailed samples was assessed in the lab at the St. Andrews Biological Station using the ICES protocol (Parrish *et al.*, 1965). A summary of the maturity stages is shown in Table 2.

The number of every tag that was released was entered into a database with all corresponding release information, including latitude, longitude, area, date and fish

condition. Tag returns were entered as they came in, along with the accompanying information on the recapture. The name of the person who returned the tag was also put into the database. Everyone who returned a tag received an entry into an annual tag draw for $1000.

Since the beginning of this program, herring have been tagged with three different colors of the same style of tags. Orange tags were used at the beginning of the program. These tags were borrowed from another project to get the weir tagging program started whilst waiting for the supply of yellow tags to be delivered. In addition, as part of our continuous collaboration with the United States tagging program, a tag exchange took place of 1000 pink tags. Due to concern over the possibility of differential return rates among tag colors, the rates were calculated and compared.

Promotion of this tagging project is vital to its success. Promotion increases awareness of the program and the amount of tags returned, as well as increasing the quality of the information that is returned with the tag. This year the tagging project was advertised using posters delivered to a large number of herring processing plants, visits to Connors Brothers, Ltd. for the tagging draw, and a trip to Nova Scotia to visit and educate processing plant workers about the project and the information we need with tag returns. In addition a 'Tagging Newsletter' was sent out to all Fundy Weir Fishermen Association members at the end of the year and this same newsletter was included in the information sent to individuals who returned tags in the month of December.

3.3 Results and Discussion

Since this project began, 46 330 herring have been tagged (Tables 3 and 4). Thus far, there have been 1 379 tags recovered. Tagging in the first year of the project began near the end of the fishing season. Between August and November 2002, twenty-one tagging events saw the placement of 13 760 tags (Mouland *et al.*, 2003). Ninety-three of these tags were returned by the early winter of that year. It was not possible to examine in-season movements of herring in 2002 because the project commenced late in the fishing season, and there were too few recoveries to analyze.

The fishery in 2003 got off to a slow start and the overall landings for the season were the lowest in twenty years (Power *et al.*, 2004). The application of tags began earlier in the 2003 fishing season than the first year of the program. Fifty-four tagging events resulted in the placement of 32 570 tags on herring in the Bay of Fundy (Tables 5 and 6). Although tagging commenced much earlier than in the first season, an even earlier start is recommended for the next season.

3.3.1 Tag Applications

The availability of herring for tagging directly depends on which weirs are fishing and the behaviour of the fish. Since 1991, landings of weir herring have been concentrated in the months of July, August and September (Power *et al.*, 2003). The application of tags in 2003 is proportional to the historical landings by month for this fishery (Figure 1). Tagging effort increased compared to landings in the second half of the year. Ideally, more effort will be placed on the earlier part of the fishing season (May and June) in order to more thoroughly examine the intra-seasonal migration and movements of herring in the area.

In 2003, no tagging took place in May and only two trips occurred in June (Figure 1 and 2). In the month of July tagging trips increased four fold. Tagging peaked in August with twenty trips and began declining in September with sixteen trips. Eight trips in October completed the season. In addition, tagging was attempted from seiners fishing in the local area in November and in January, but high winds and bitter temperatures hindered efforts. Tagging locations by month and area are shown in Table 5 and Figure 2.

Tagging locations have been broken down into eight tagging areas to aid in the interpretation of the data (Figure 3). In 2003 the majority of the tagging effort was concentrated in weirs on Grand Manan and the West Isles, followed closely by the Bliss Island area.

The majority of fish tagged were small juveniles (Figure 4) but, during some tagging events, it was obvious that there were two size groups of fish present in the weir. Herring that are landed in the weir fishery are composed primarily of juvenile herring (ages 1 to 3) and some adults (Power *et al.*, 2002; Mouland *et al.*, 2003). A protocol was implemented to tag each size class with a different series of tag numbers in this situation. This information was later noted in the database in order to track the movements of the larger, older fish separately from the smaller, younger ones.

The complete biological detail information for length and maturity of the herring tagged in 2003 is shown in Appendix A. Mixtures of fish of various sizes and stages of maturity were observed in samples from Bliss Island, the West Isles and Grand Manan areas. Eight out of thirteen tagging samples (August 11 to October 7) from the Bliss Island area showed a bimodal length frequency distribution (Appendix A). The maturity frequency distributions show fish at stages 4 to 6 for these eight samples (Appendix A). To date there have been five tag returns from the Scots Bay spawning grounds from fish that were tagged in the Bliss Island area.

In 2003, samples from three out of ten tagging trips in the West Isles area contained stage 5 or 6 fish (Deep Cove weir on August 20 and 26, and Abnaki Weir on October 7). Likewise, three out of ten samples from the Grand Manan area contained prespawning fish (September 9) and spawning fish (September 16 and 21). Herring are known to spawn in the Grand Manan area in the early fall (Stephenson *et al.*, 1998) so it was not surprising that these larger, spawning fish were present.

3.3.2 Days at Large

It is evident from the number of tag returns that tagged herring are surviving the initial tagging experience. From the returns, it is also demonstrated that tagged herring can survive on a long term basis. The fish that was at large for the longest period of time from this program, thus far, was recaptured after 409 days. Fish are most frequently recovered after thirteen days (mode) (Figure 5). Ninety-five percent of the tags returned are recaptured within the first four months.

3.3.3 Tag Returns

A total 1 379 of tags were returned since 2002. Thirty tags were returned from herring tagged in the 2002 season and 1 115 tags were from fish tagged in the 2003 season. In addition, fifteen tags were returned from tagging trips that had been conducted prior to the weir tagging program. Of all the tags returned, 289 (~21%) were returned with incomplete information. Returns are shown by year tagged for all weir tagging events, including the project prior to this one in Figures 6 and 7 and Tables 5 and 7. The 2003 tag returns for the weir project are shown by month in Figure 7.

The recapture of 1 379 tags establishes an overall return rate of 3% (Table 8), calculated for all tags returned since the beginning of the weir tagging program. This is comparable to the return rate documented in other herring tagging experiments in the same area (McKenzie and Tibbo, 1958; McKenzie and Skud, 1958, Stobo *et al.*, 1975). Interestingly, the return rates by color show that the pink tags have the highest rate of return at 13%, followed by the yellow tags at just over 3% and the orange at just over 2%.

3.3.4 In Season Migration - 2003

The objective of identifying migration and movement patterns of herring within a single fishing season is gradually being met. The late start in the first season made it impossible to look at this factor for the first year of the project. Some preliminary results are shown here for the second year of tagging, and at present are merely descriptive in nature.

Unfortunately tagging did not commence until July 2003 due to low landings. Therefore the movements of fish early in the season are unknown. There were, however, sufficient tag returns from tags applied in two areas for the examination of intra-seasonal movements within the Bay of Fundy. These are the Bliss Islands and Grand Manan areas.

A total of 9 305 tags were applied during ten tagging trips to Grand Manan in 2003. Tag returns from fish caught more than four days after tagging were examined to see if there was any pattern (Figure 8). The majority of returns from these trips were from the Grand Manan, Bliss, Campobello, Wolves and coastal mainland areas (Figure 8). In August 2003, along with the tags returned from the local area, there were two tag returns from Sandy Cove, Nova Scotia close to the end of the month (Figure 8). In September there were three returns from the German Bank spawning grounds, one from Sandy Cove and two from Mount Desert Rock in U.S. waters. In the fall and winter (October – January), the majority of returns were from Grand Manan and the Wolves, coincident with the winter purse seine fishery. Fish tagged in the Grand Manan area appear to be a mixture of different origins. The majority of returns show that the tagged fish stay in the local tagging area. However, tagged herring were also found on the other side of the Bay of Fundy, German Bank, and in U.S. waters. This is consistent with the hypothesis that this is a complex of more than one group (Stobo *et al.*, 1975).

A total of 9 719 tags were applied during thirteen trips to the Bliss Island area in 2003. Again, only tag returns from fish caught more than four days after tagging were examined (Figure 9), and similar to the results from tagging around Grand Manan, the majority of returns show that the tagged fish stay in the local tagging area. In August, 2003, there were also five returns from Schoodic Ridge, U.S.A. and one from Sandy Cove, Nova Scotia in the later part of the month. In September there were sixty tag returns. Two of the returns were from the spawning grounds at Scots Bay followed by six returns from Sandy Cove near the end of the month. In October there were forty-nine tag returns, all but one of which was from the coastal tagging area. In November and January, eleven of the twelve tag returns were from the winter purse seine fishery off Grand Manan and the Wolves and one from Scantum Basin, Massachusetts. Tagged herring from the Bliss Islands tended to stay in the area throughout the fishing season, and also appeared in other areas such as the other side of the Bay of Fundy, Gulf of Maine, Scots Bay, and in U.S. waters, again consistent with Stobo's (1975) results.

3.3.5 Long Term Movement and Migration

There have been 139 tag returns from the 2002 season. Thirty (0.2%) of these tags were returned during the 2003 season. Given this return rate we can expect a minimum of seventy-two tags from the 2003 season to be returned in 2004. The majority of tag recoveries are from the weir fishery. However, there were also sixteen returns from US waters, five from German Bank, and three from Scots Bay (Table 9). One tag was returned from a fish tagged from a Nova Scotian Weir in September, 2003. This herring was recaptured at The Wolves Islands (Table 4).

3.4 Conclusion

The second season of the herring weir tagging project was successfully completed. The first two seasons have provided some descriptive preliminary results. Most tag recoveries have been from the local tagging area, and are concentrated in the areas where fishing effort was placed. These areas include the summer herring weir fishery and purse seine catches around Grand Manan and the Wolves in the fall. There have also been tag recoveries from US waters as far away as Ipswich Bay as well as from spawning grounds in Scots Bay and German Bank.

3.5 Recommendations

It is recommended that:

- this project continues with an emphasis on tagging early in the fishing season.
- tag shedding and mortality studies be conducted to determine the amount of tag loss and mortality due to tagging.
- more advertisement is necessary for the coming year, given the large amount of tags that were returned without adequate information. Several of the tags that have been returned have been from lobster fisher's bait. Increasing awareness and setting up a protocol to trace lobster bait back to the catch location would be one area of improvement. Another would be to remind current plant employees and to educate new employees about the tagging program and the information that is required with a tag return.

- there be continued cooperation and data exchange with the Maine Department of Marine Resources tagging program. An additional 800 US tags will be applied to weir fish in Canada and 1 000 Canadian tags will be applied to fish in US waters to examine any difference in return rate.

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Table 1: PRC/HSC Tag returns in from April 1, 2003 to March 1, 2003

Tagging Location	Tagging Date	Return Location	Return Date	Days at Large
Chebucto Head	9-Jan-02	German Bank	24-Jun-03	531
	9-Jan-02	German Bank	10-Jul-03	547
	9-Jan-02	German Bank	11-Jul-03	548
	10-Jan-02	German Bank	10-Aug-03	577
	10-Jan-02	German Bank	5-Oct-03	633
	9-Jan-02	Moore's Ledge	28-Jul-03	565
	5-Jan-01	Moore's Ledge	27-Jul-03	933
	9-Jan-02	Grand Manan	5-Aug-03	573
	9-Jan-02	Scots Bay	3-Aug-03	571
	10-Jan-02	Teardrop Weir	3-Jul-03	539
	4-Jan-01	Teardrop Weir	3-Jul-03	910
	9-Jan-02	Unknown	20-Jun-03	527
	10-Jan-02	Unknown	28-Nov-03	687
	5-Jan-01	Unknown	29-Jul-03	935
German Bank	17-Sep-01	German Bank	02-Sep-03	715

Table 2: Maturity staging for herring as applied at the St. Andrews Biological Station (Parrish, 1965).

Stage	Males	Females
1	Virgin herring. Testes very small, threadlike, whitish or grey-brown.	Virgin herring. Ovaries very small 1-3mm broad, wine-red or pinkish color.
2	Virgin herring with small sexual organs. Width of testes about 3-8 mm. Wedge shaped with a knife edge in cross section and reddish grey in color.	Virgin herring with small sexual organs. Width of ovaries about 3-8mm, eggs not visible to naked eye but can be seen with magnifying glass, oval in cross-section, wine-red or pinkish.
3	Testes about half the length of body cavity. Width of testes between 1-2 cm, reddish grey or greyish color, double lobe at distal end.	Ovaries about half the length of body cavity. Width between 1-2 cm, distal end is torpedo shaped, eggs small but can be distinguished with naked eye, overall color is orange.
4	Testes almost as long as body cavity and whitish in color.	Ovaries almost as long as body cavity. Eggs larger, varying in size, eggs opaque. Overall color is orange or pale yellow.
5	Testes fill body cavity, testes milk white. Sperm does not flow but can be sometimes be extruded by firm pressure.	Ovaries fill body cavity. Yellowish in color. Eggs large, round, some transparent but do not flow with pressure.
6	Testes ripe, white color and sperm flows freely.	Ovaries ripe. Eggs transparent and flowing freely.
7	Spent herring. Testes baggy and bloodshot but may contain remains of whitish sperm.	Spent herring. Ovaries baggy and bloodshot, empty or containing only a few residual eggs.
8	Recovering spent. Testes firm and larger than virgin herring at stage 2. Walls of testes striated, blood vessels prominent, testes dark wine-red in color. (This stage passes into Stage 3)	Recovering spent. Ovaries firm and larger than virgin herring at stage 2. Eggs not visible to naked eye. Walls of ovary striated, blood vessels prominent, dark wine-red in color. (This stage passes into Stage 3)
0	Unable to determine stage.	Unable to determine stage.

Table 3: Tag applications by month and location for 2002.

2002

Location	May –June	July	August	September	October	November	Totals
Bliss Islands	0	0	640	2201	1275	0	4116
Grand Manan	0	0	0	229	0	1021	1250
West Islands	0	0	0	3493	2266	0	5759
Deer Island	0	0	0	1129	0	0	1129
Wolves	0	0	0	1006	500	0	1506
Nova Scotia	0	0	0	0	0	0	0
Campobello	0	0	0	0	0	0	0
Coastal Mainland, NB	0	0	0	0	0	0	0
Totals	**0**	**0**	**640**	**8058**	**4041**	**1021**	**13760**

Table 4: Tag application by month and location for 2003.

2003

Location	May –June	July	August	September	October	November	Totals
Bliss Islands	393	800	2912	1248	250		5603
Grand Manan	773	3050	1797	2435			8055
West Islands		896	4133	1370	1885		8284
Deer Island			900	2124	675		3699
Wolves		400		1351	2400		4151
Nova Scotia				241			241
Campobello				296			296
Coastal Mainland, NB		1000	800	441			2241
Totals	**1166**	**6146**	**10542**	**9506**	**5210**		**32570**

Table 5: Tag returns and releases by area for 2002 and 2003.

	Bliss Island	Coastal Mainland NB	Deer Island	Grand Manan	Nova Scotia	West Isles	Wolves	Campobello	Totals
Total Tagged →	*9719*	*2241*	*4828*	*9305*	*241*	*14043*	*5657*	*296*	*46330*
Return Area ↓									
Bay of Fundy	2			1		1			**4**
Bliss Islands	15	2		2		7			**26**
Campobello	11		1			3			**15**
Coastal Mainland NB	25	2	3	3		18	5		**56**
Deer Island	15	1	11	1		20	7		**55**
Eastern Bay of Fundy	8		1	5		7			**21**
German Bank	1			2					**3**
Grand Manan	16	3	2	55		26	7		**109**
Gulf of Maine	1								**1**
NB Weir	34	5	10	12		16	7		**84**
Northeast Bank	2						1		**3**
Scots Bay	2								**2**
Southwest Bank	1	1	1			1	4		**8**
The Prong	1		3	1		2			**7**
USA	8	1	1	2		3	1		**16**
West Isles	2	1	1	1		8	1		**14**
Wolves	56	14	45	27	1	161	210		**514**
Totals	**200**	**30**	**79**	**112**	**1**	**273**	**243**	**0**	**938**

Table 6: Tag application log for 2003.

Date	Weir/Location	Total Tagged	Running Total
16-Jun-03	Money Cove Weir	773	773
17-Jun-03	Outer Lighthouse (Tuckers) Cove Weir	393	1166
09-Jul-03	Gully Weir	400	1566
09-Jul-03	Money Cove Weir	929	2495
14-Jul-03	Money Cove Weir	746	3241
17-Jul-03	Fry (James) Weir	800	4041
17-Jul-03	Combination Weir	1000	5041
21-Jul-03	Mystery Weir	975	6016
29-Jul-03	Pinafore Weir	896	6912
30-Jul-03	Flatpot (Bills Luck) Weir	400	7312
07-Aug-03	Rattle Rock Weir	500	7812
07-Aug-03	Carney's Cove (Spruce Island) Weir	400	8212
08-Aug-03	Corabell Weir	1098	9310
10-Aug-03	Jubilee Weir	397	9707
10-Aug-03	Mystery Weir	302	10009
11-Aug-03	Eagle Island Weir	199	10208
12-Aug-03	Eagle Island Weir	592	10800
14-Aug-03	Fry (James) Weir	300	11100
14-Aug-03	Outer Lighthouse (Tucker's) Cove Weir	206	11306
14-Aug-03	Rattle Rock Weir	400	11706
14-Aug-03	Carney's Cove (Spruce Island) Weir	350	12056
17-Aug-03	Flower Pot Weir	800	12856
19-Aug-03	Eagle Island Weir	300	13156
20-Aug-03	Deep Cove Weir	335	13491
25-Aug-03	Eagle Island Weir	615	14106
25-Aug-03	Pinafore Weir	949	15055
26-Aug-03	Deep Cove Weir	500	15555
27-Aug-03	Pinafore Weir	750	16305
28-Aug-03	Spider Cove Weir	700	17005
28-Aug-03	Batchlor Weir	849	17854
02-Sep-03	Eagle Island Weir	399	18253
08-Sep-03	Eagle Island Weir	450	18703
09-Sep-03	Grand Manan - Mumps	550	19253
10-Sep-03	Hog Island	399	19652
11-Sep-03	NS Sandy Cove	241	19893
14-Sep-03	Grand Manan - Eagle Rock	785	20678
14-Sep-03	Millcove - Campobello	296	20974
16-Sep-03	Brown #1	550	21524
16-Sep-03	The Beach	449	21973
16-Sep-03	Burnt Boot	801	22774
18-Sep-03	Gully Weir	370	23144
21-Sep-03	Gully Weir	330	23474
22-Sep-03	Shut-off	2124	25598
23-Sep-03	Back of Bar Is.	921	26519
24-Sep-03	Moose Is.	441	26960
30-Sep-03	Gully Weir	400	27360
02-Oct-03	Burnt Boot	600	27960
02-Oct-03	Wolf Weir	1150	29110
07-Oct-03	Rattle Rock Weir	675	29785
07-Oct-03	Pup Weir	200	29985
07-Oct-03	Hog Island	250	30235
07-Oct-03	Abnaki Weir	935	31170
07-Oct-03	Bar Weir	750	31920
09-Oct-03	Burnt Boot	650	**32570**

Table 7: Recoveries from weir tagging applications in 1999 and 2000.

Area Tagged	Return Area	# of Returns	Area Tagged	Return Area	# of Returns
Bliss Islands	Bliss Islands	5	West Isles	Browns Bank	1
	Grand Manan	6		Chebucto Head	1
	Long Island Shore	5		Grand Manan	10
	NB Weir	22		NB Weir	7
	Wolves	3		Nova Scotia	1
Campobello	Bliss Islands	1		The Prong	3
	Campobello	3		USA	2
	Grand Manan	1		West Isles	2
	Long Island Shore	2		Wolves	5
	NB Weir	2	Wolves	Bliss Islands	4
	USA	1		Campobello	1
	Wolves	1		Chebucto Head	1
Grand Manan	Browns Bank	1		Georges Bank	1
	Grand Manan	3		Grand Manan	17
	Long Island Shore	1		Long Island Shore	4
	NB Weir	5		NB Weir	14
	USA	1		Northeast Bank	2
	Wolves	2		Wolves	23

Table 8: Overall tag return rate and return rate broken down by color.

	Number released	Number returned	Return Rate %
Orange Tags	5999	124	2
Pink Tags	300	39	13
Yellow Tags	40031	1216	3
Overall	46330	1379	**3**

Table 9: Weir tagging (2002&2003) recoveries from locations outside of the NB Weir area.

Return Location	Area Tagged	Return Location	Size of fish tagged
USA	Bliss Islands	Schoodic Ridge	Large Fish
	Bliss Islands	Long Point, Cutler, Maine	Large Fish
	West Isles	Schoodic Ridge	Large Fish
	Grand Manan	Mt. Desert Rock	Small Fish
	Coastal Mainland	Schoodic Ridge	Small Fish
	West Isles	Schoodic Ridge	Large Fish
	Bliss Islands	Schoodic Ridge	Large Fish
	Bliss Islands	Schoodic Ridge	Large Fish
	West Isles	Schoodic Ridge	Large Fish
	Wolves	USA - East of New Harbour	Small Fish
	Bliss Islands	Rockland - Matinicus Rock	Large Fish
	Bliss Islands	Ipswich Bay, US	Two Sizes - Unknown
	Grand Manan	Mt. Desert Rock	Small Fish
	Bliss Islands	Schoodic Ridge	Large Fish
	Bliss Islands	Scantum Basin, Cape Anne, Massachussetts	Small Fish
	Deer Island	USA	Small Fish
Scots Bay	Bliss Islands		Large Fish
	Bliss Islands		Large Fish
	Bliss Islands		Two Sizes - Unknown
German Bank	Bliss Islands		Small fish
	Grand Manan		Large fish
	Grand Manan		Mixture (98% small)
	Grand Manan		Large fish
	Grand Manan		Small fish

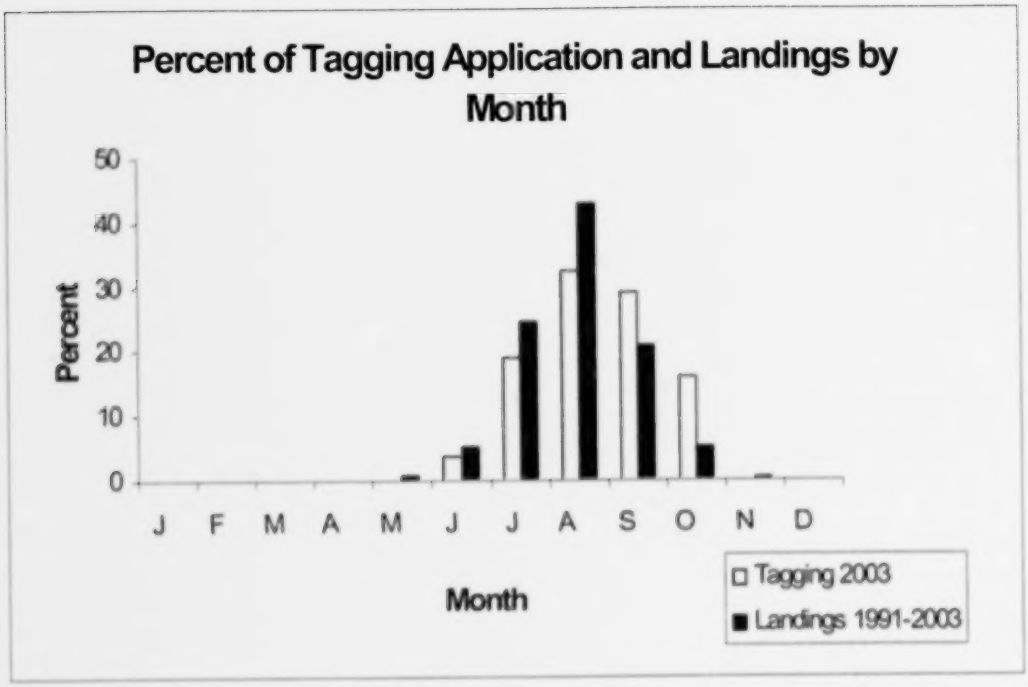


Figure 1: Percent of tag applications by month compared to weir landings by month.

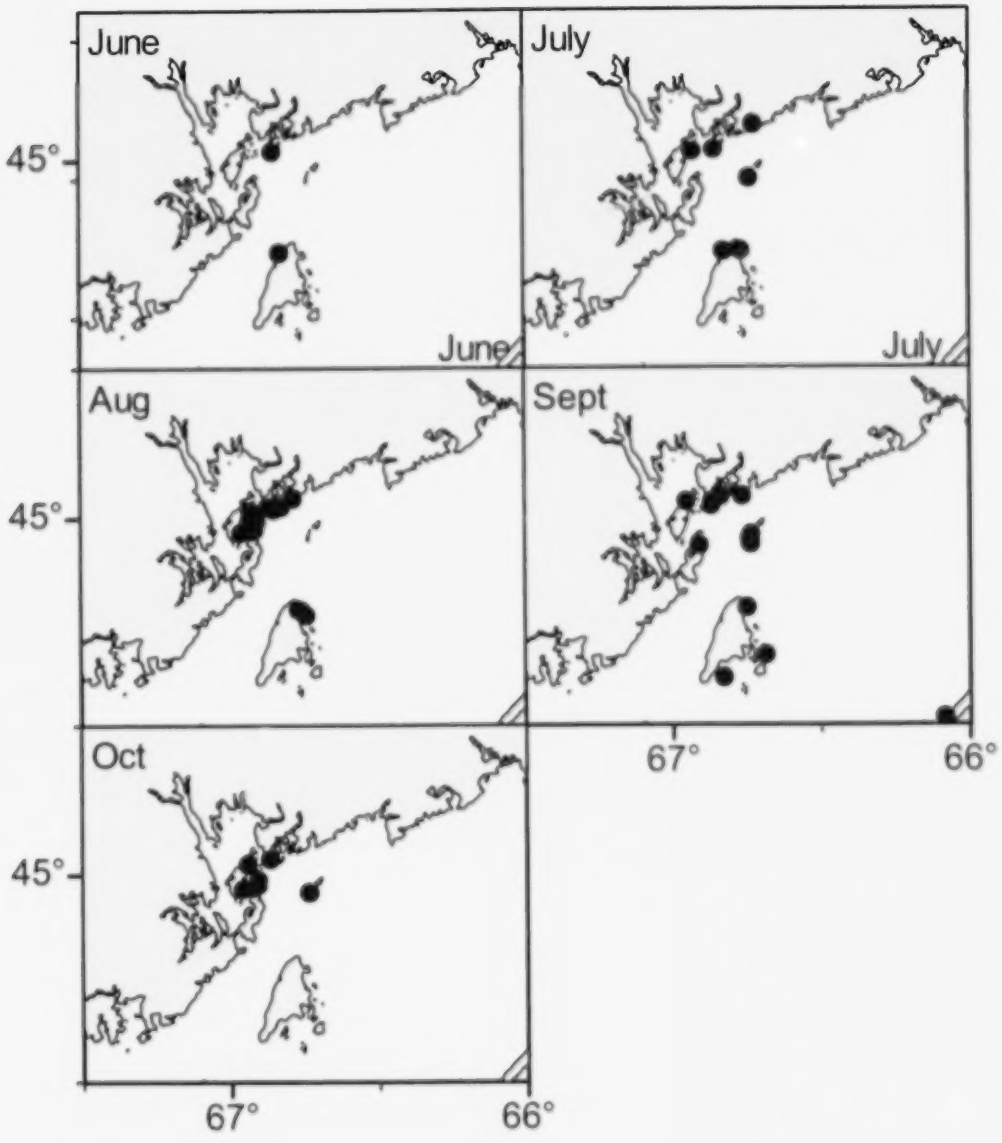


Figure 2: Tag applications sites by month for 2003.

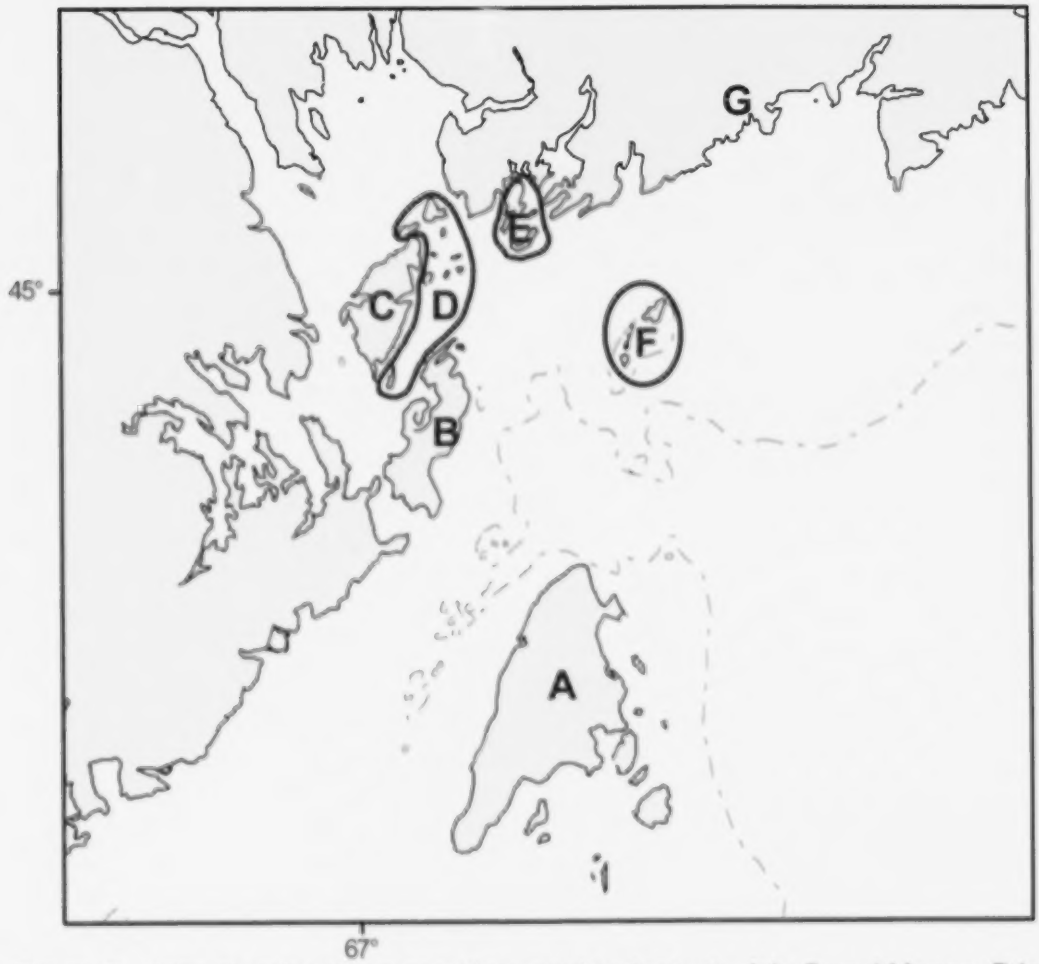


Figure 3. Map showing the areas discussed in the text. A is Grand Manan, B is Campobello Island, C is Deer Island, D is the West Isles, E is Bliss Island area, F is the Wolves Islands and G is the Coastal Mainland area.

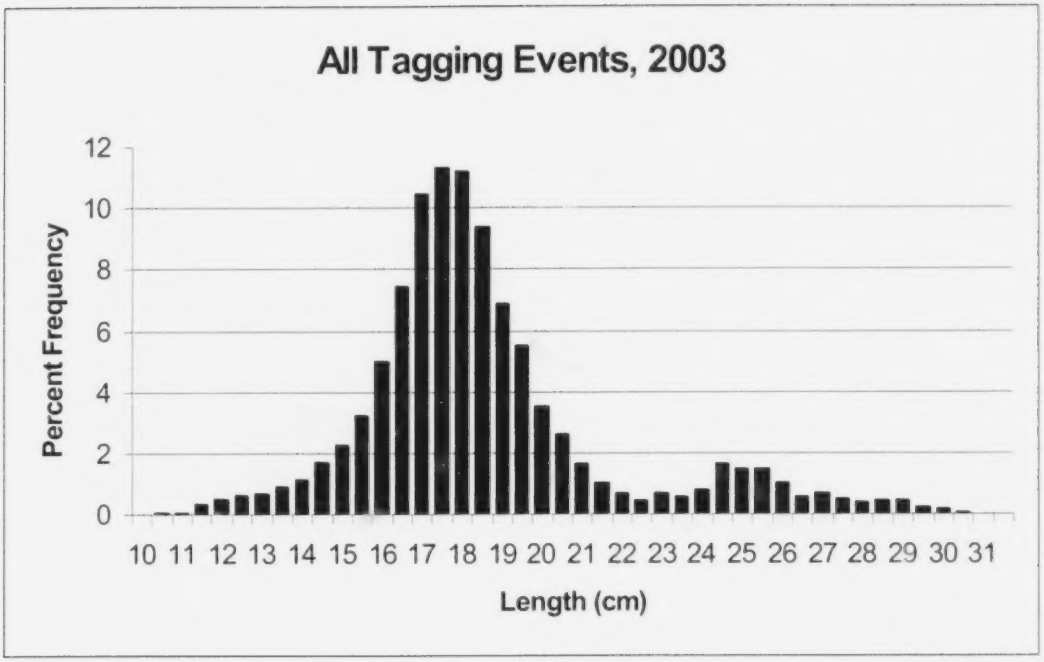


Figure 4: Length frequency samples of all tagging trips in 2003.

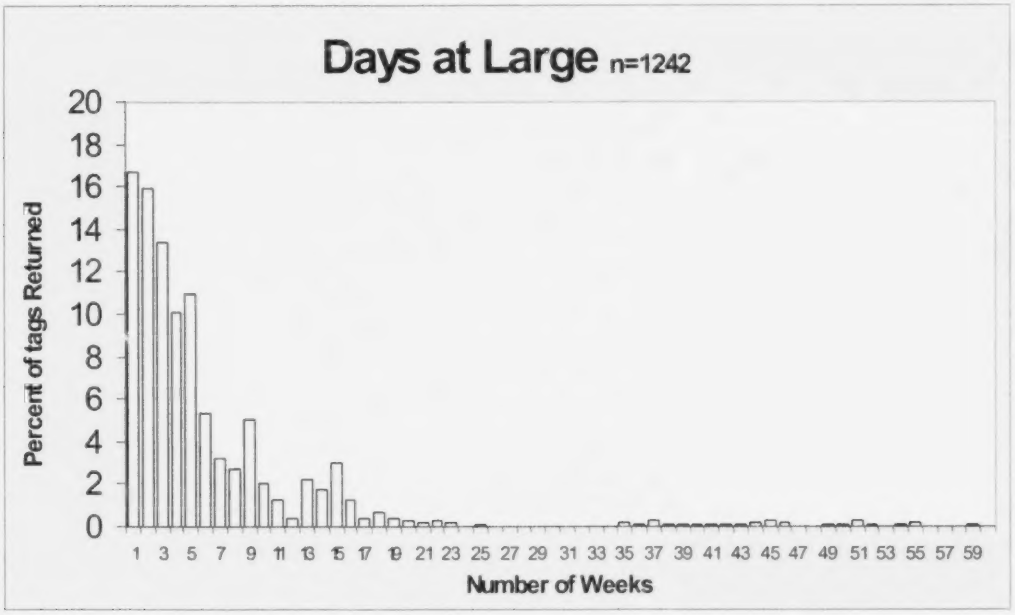


Figure 5: Amount of time each tag return spends at sea.

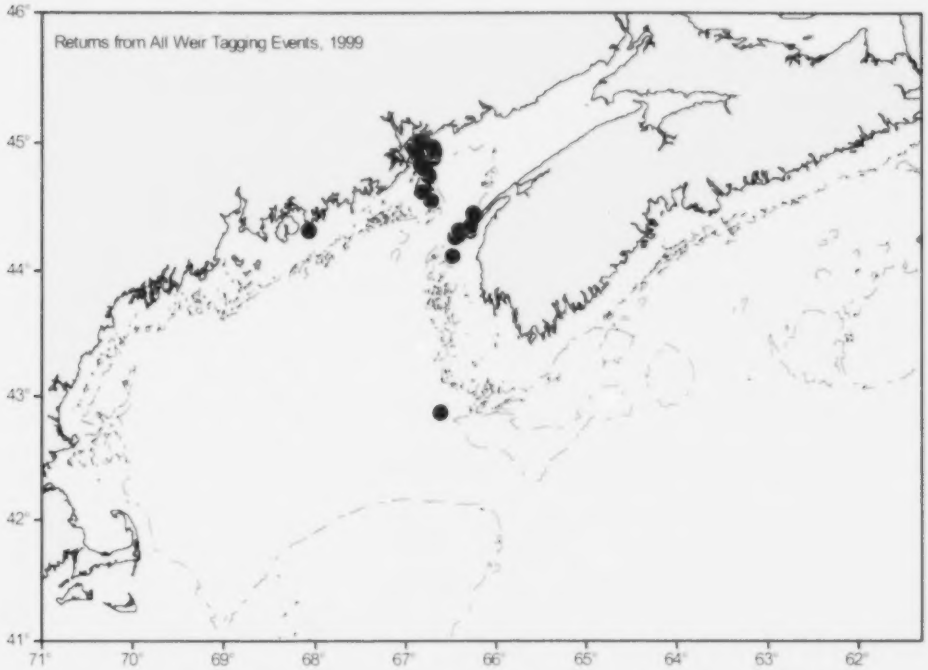


Figure 6a. Tag returns from tagging events that occurred in 1999.

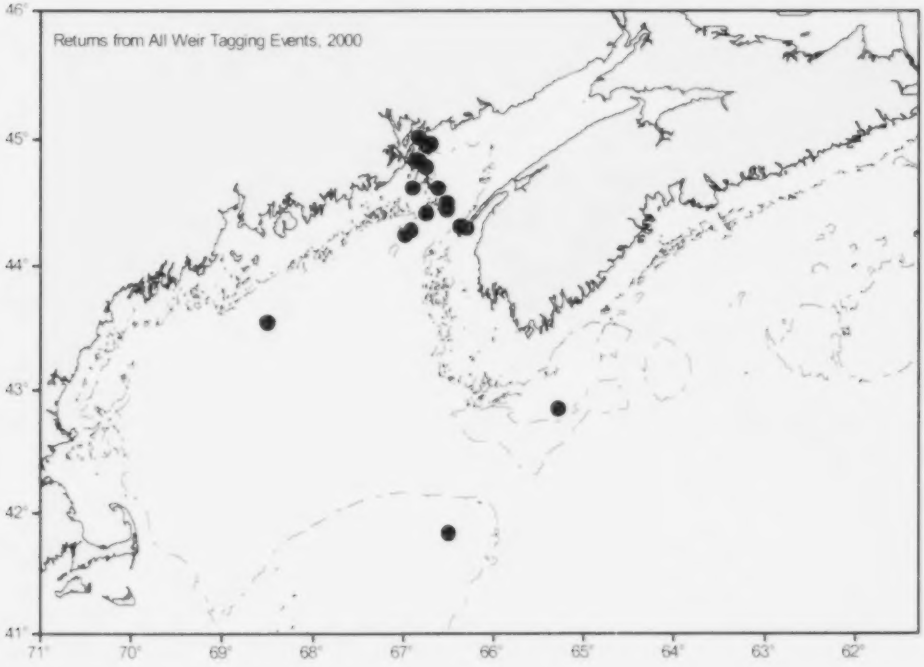


Figure 6b. Tag returns from tagging events that occurred in 2000.

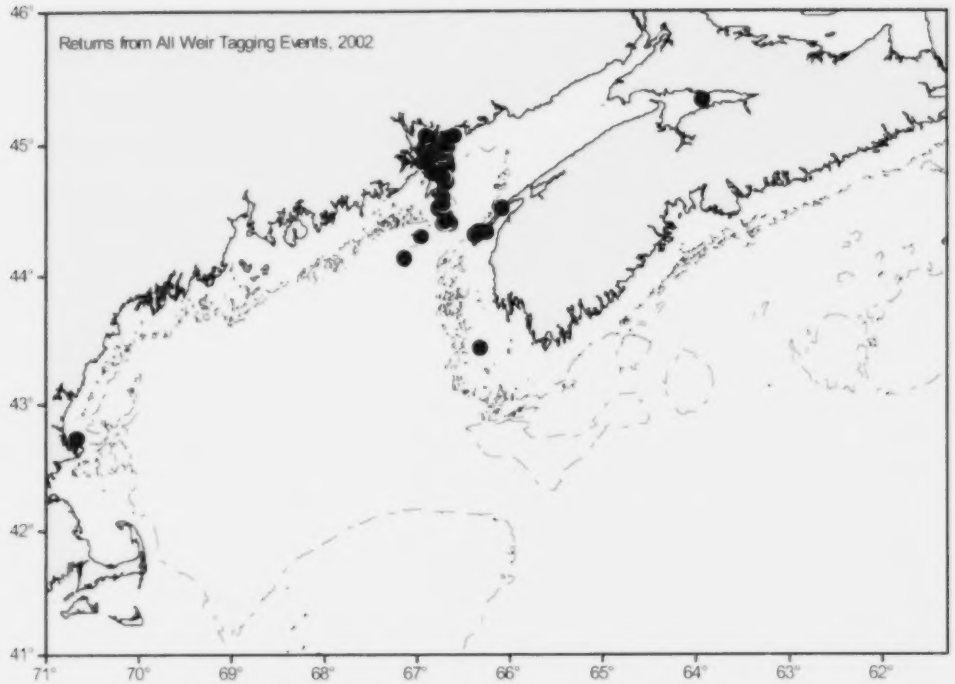


Figure 6c. Tag returns from tagging events that occurred in 2001.

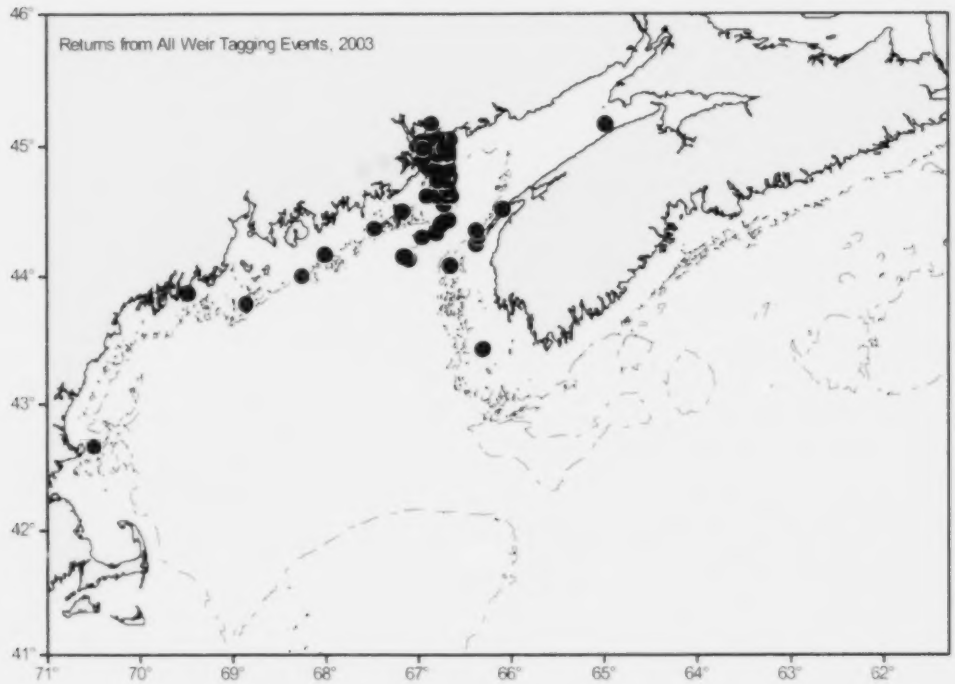


Figure 6d. Tag returns from tagging events that occurred in 2003.

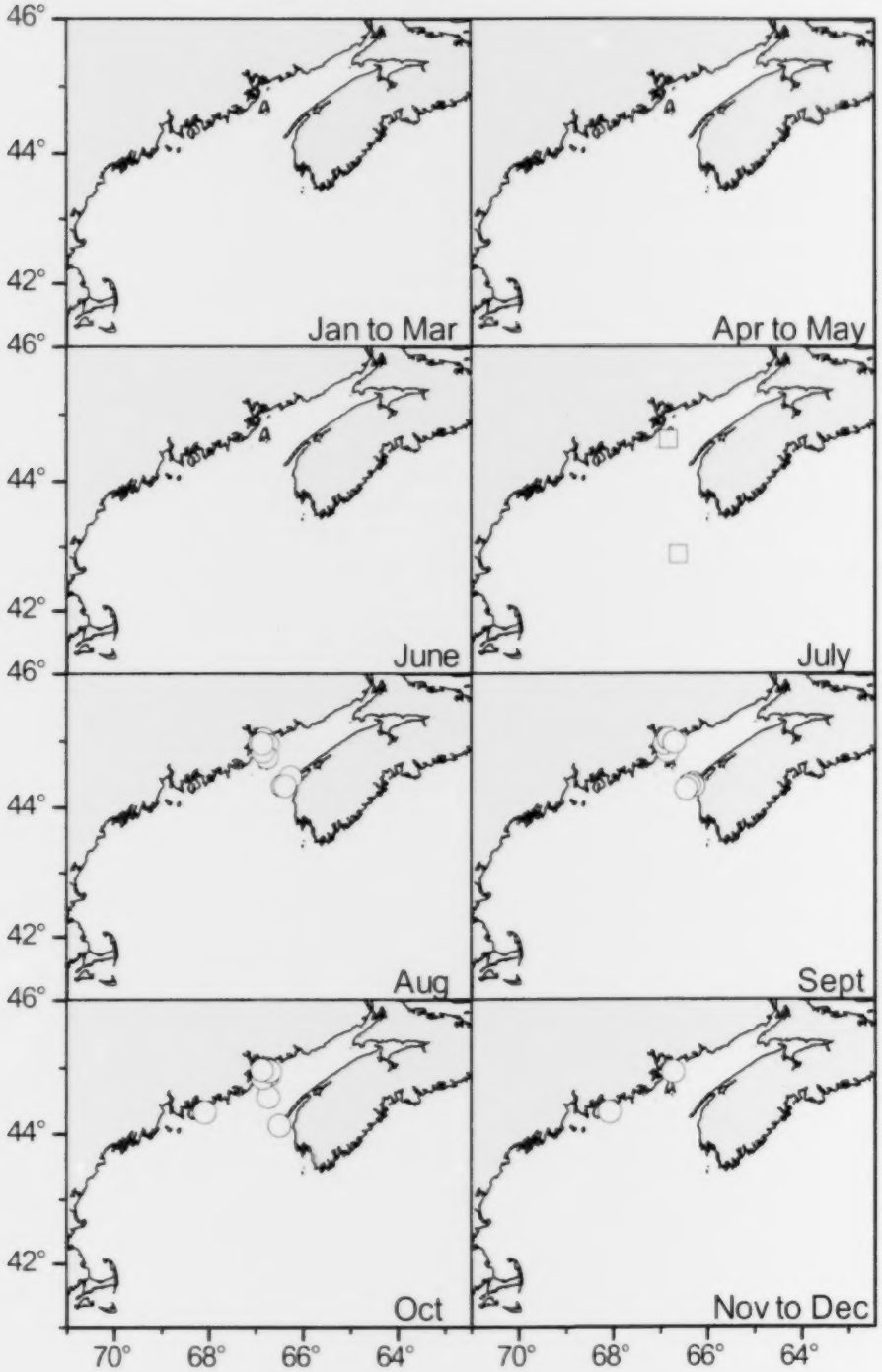


Figure 7a. Tag returns from herring tagged during the 1999 fishing season. Opencircles indicate returns from 1999 and squares indicate returns from 2000.

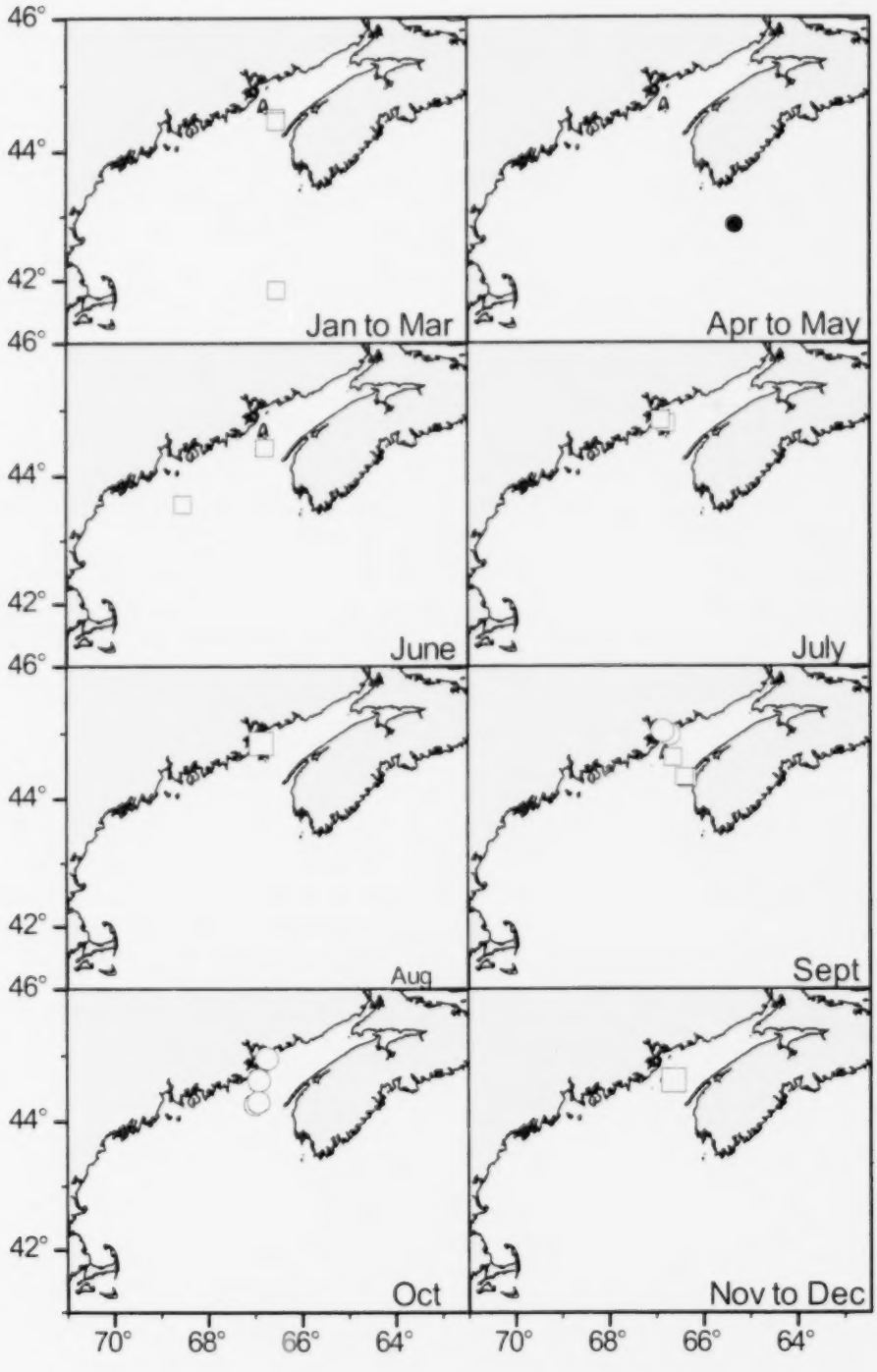


Figure 7b. Tag returns from herring tagged during the 2000 fishing season. Open circles Indicate returns from 2000, squares indicate returns from 2001, and the closed Circle indicates a return from 2002.

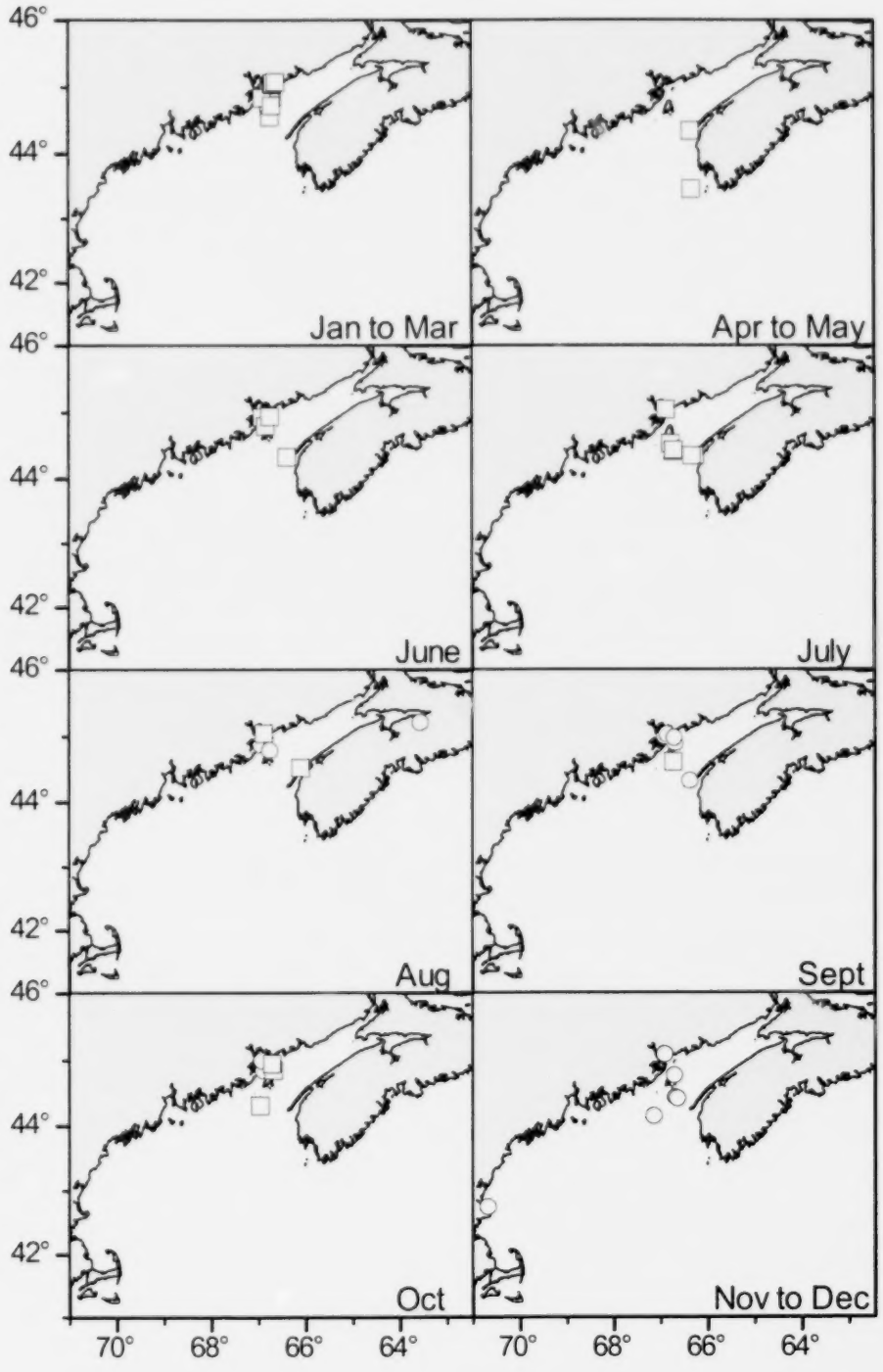


Figure 7c. Tag returns from herring tagged during the 2002 fishing season. Open circles indicate returns from 2002 and squares indicate returns from 2003.

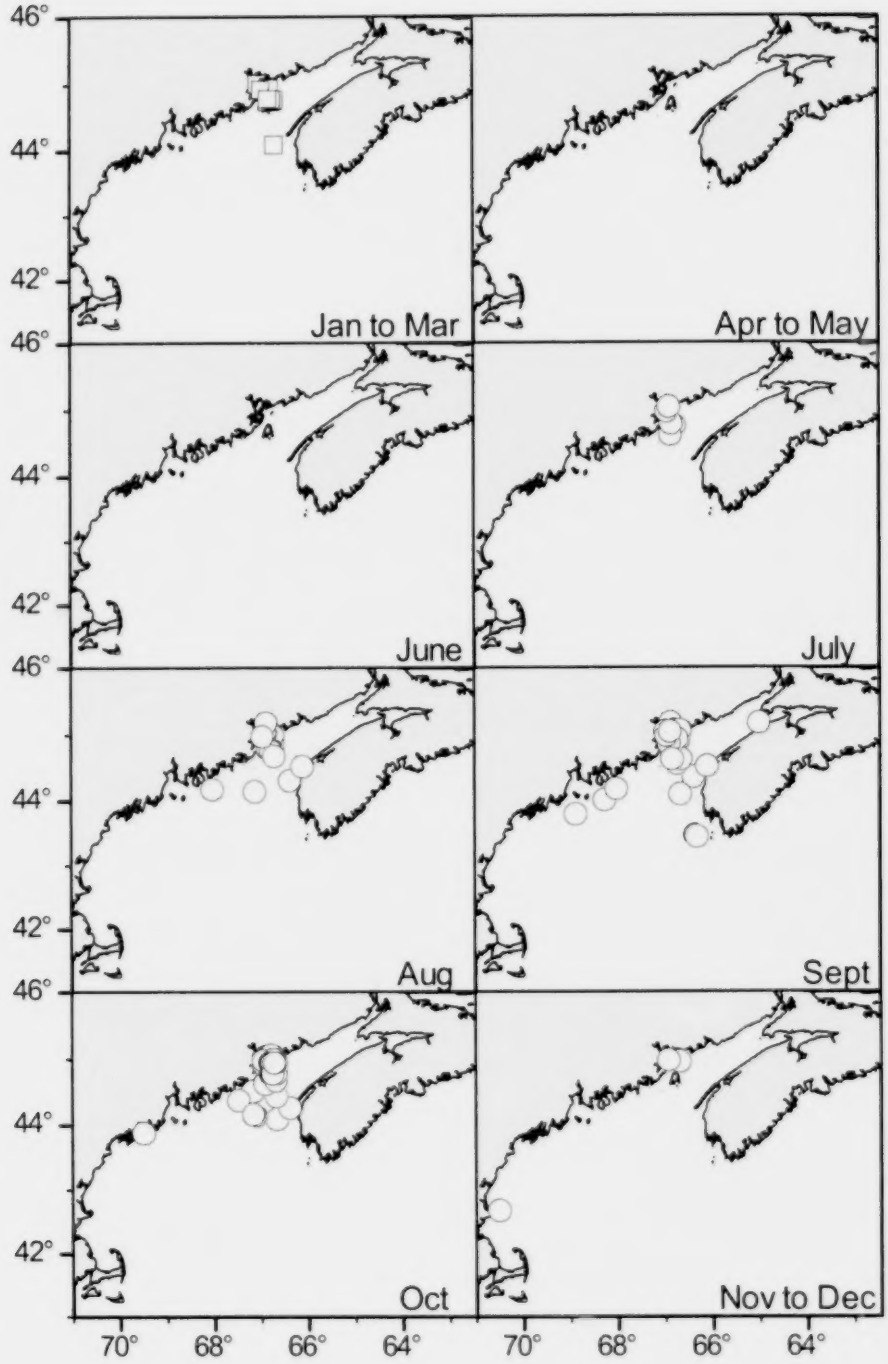


Figure 7d. Tag returns from herring tagged during the 2003 fishing season. Open circles indicate returns from 2003.

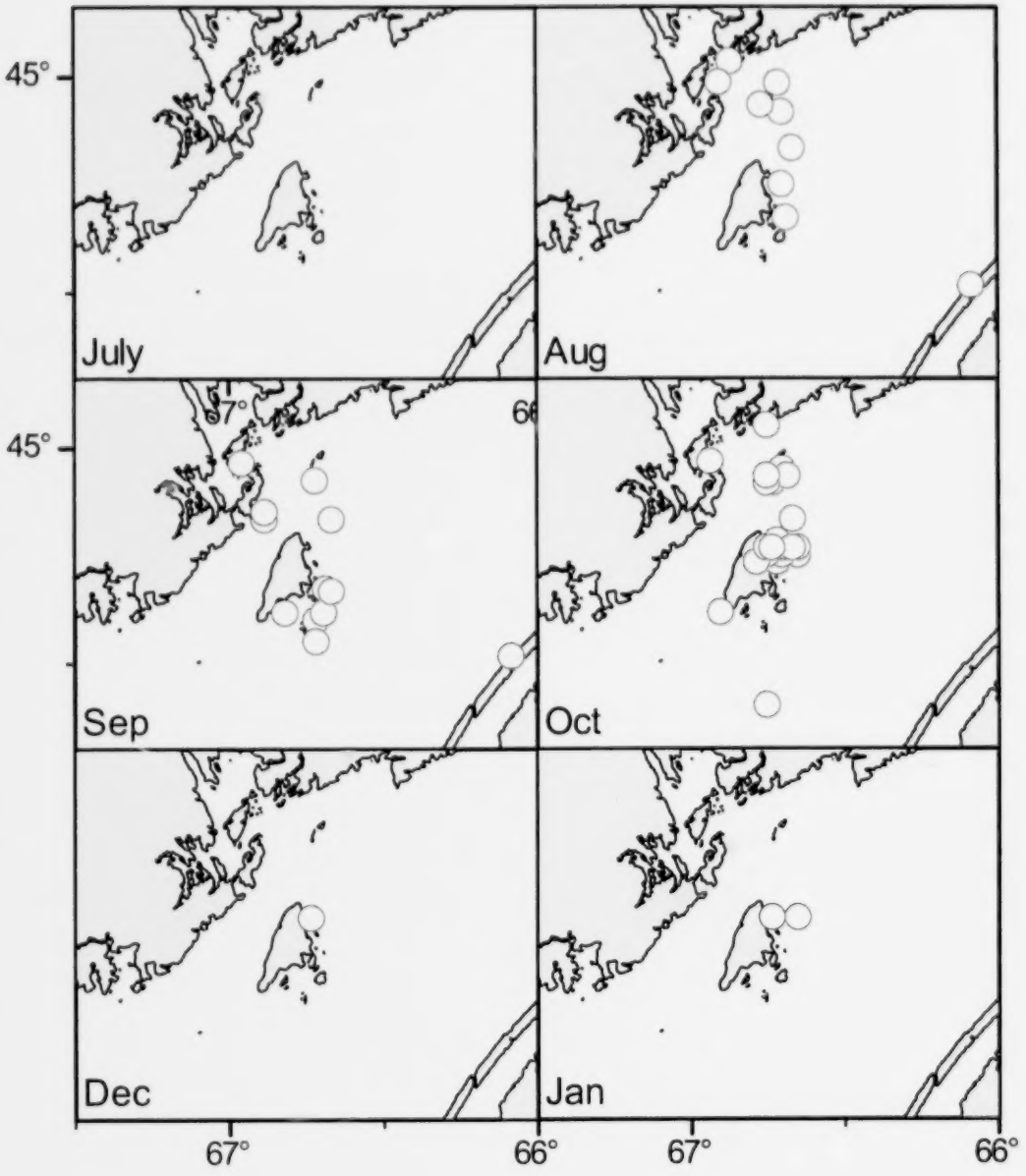


Figure 8. Tag returns by month for herring tagged from Grand Manan weirs in 2003. Only returns from four or more days after the tagging event are included.

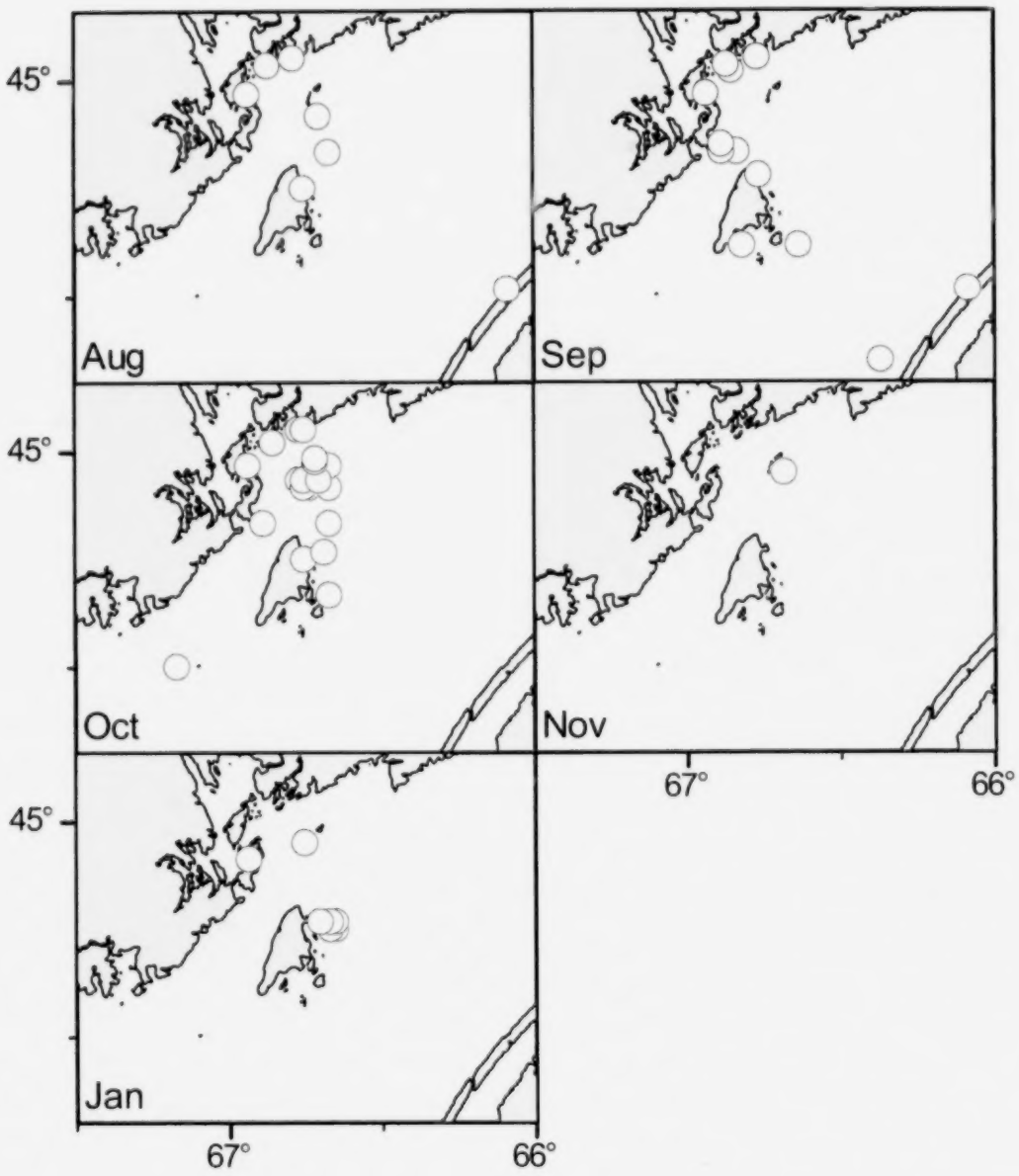


Figure 9. Tag returns by month for herring tagged from Bliss Island weirs in 2003. Only returns from four or more days after the tagging event are included.

Appendix A

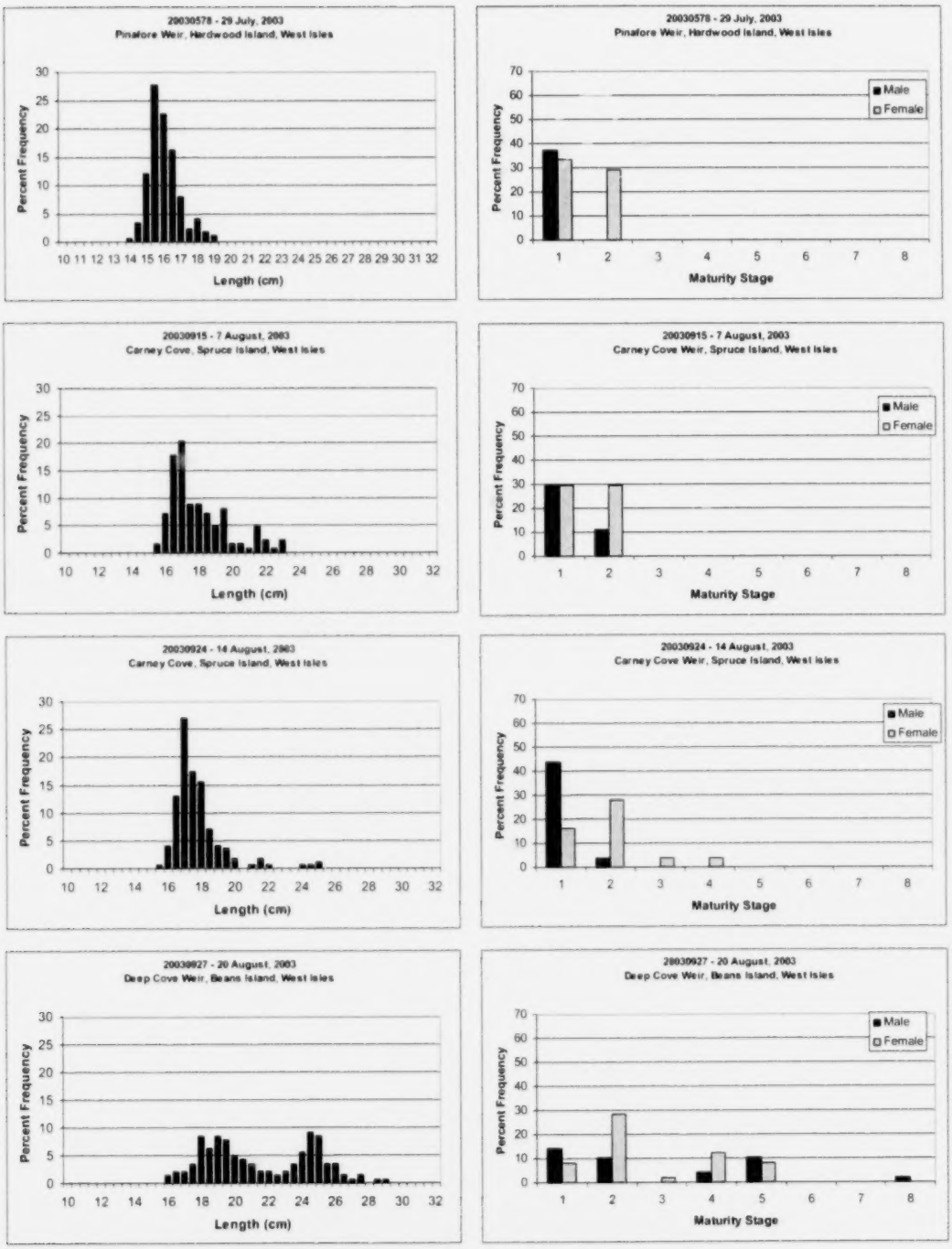
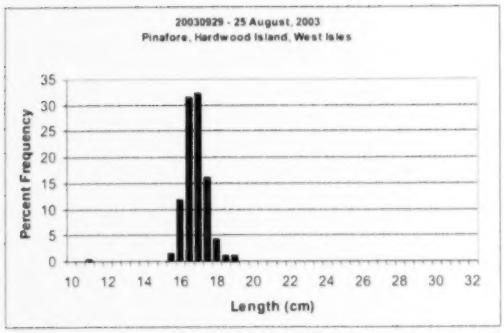
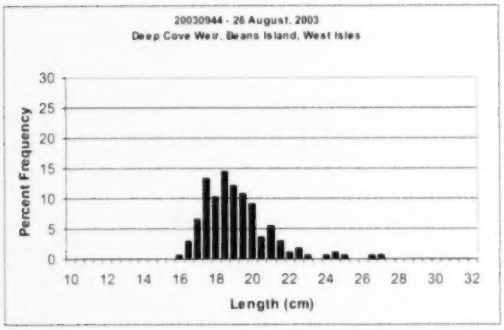
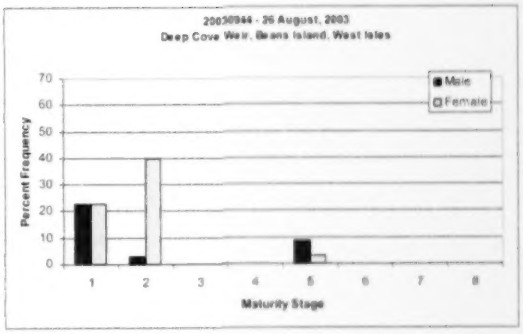
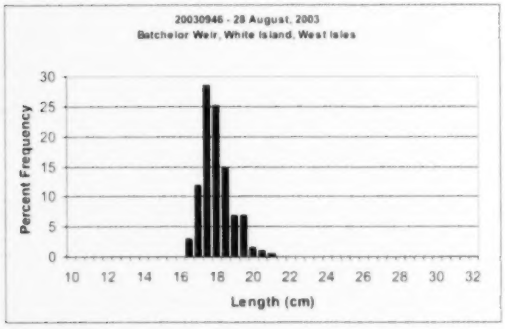


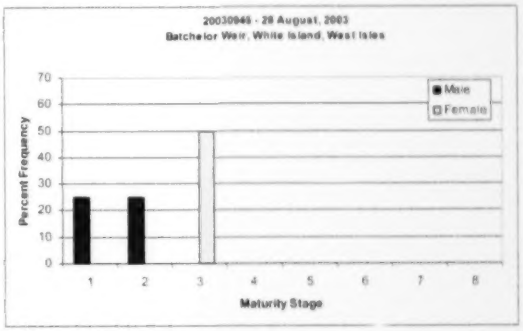
Figure 1a: West Isles tagging samples.

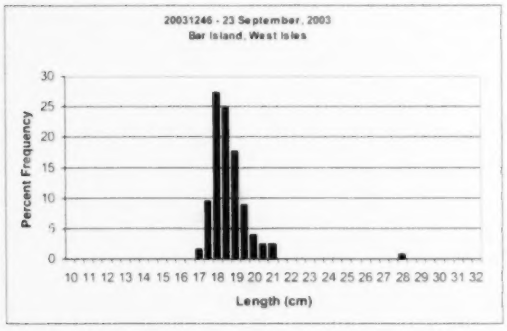












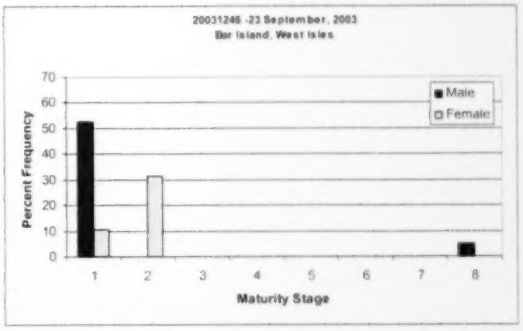
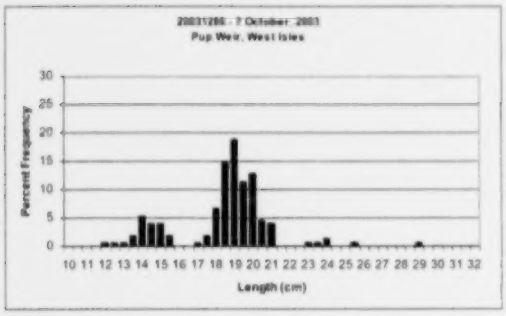
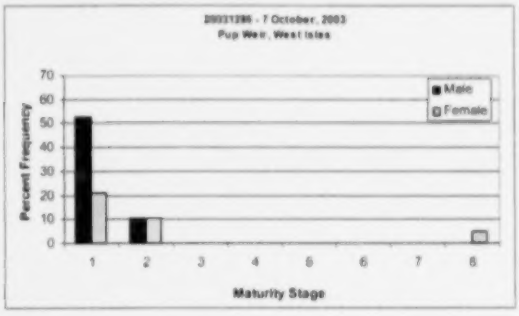
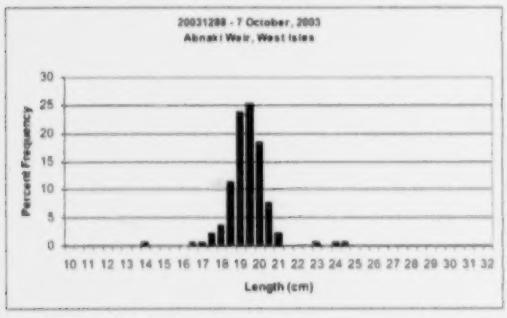


Figure 1b: West Isles tagging samples continued. No maturity data were available for August 25, 2003.







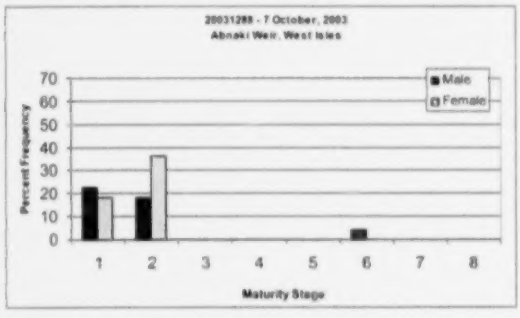
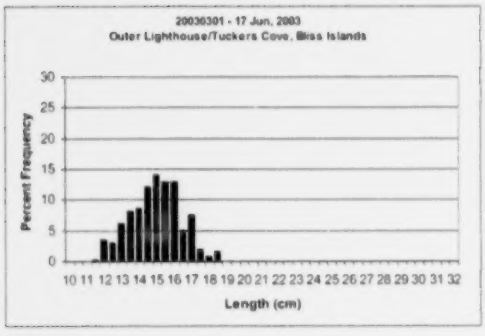


Figure 1c: West Isles tagging samples continued.



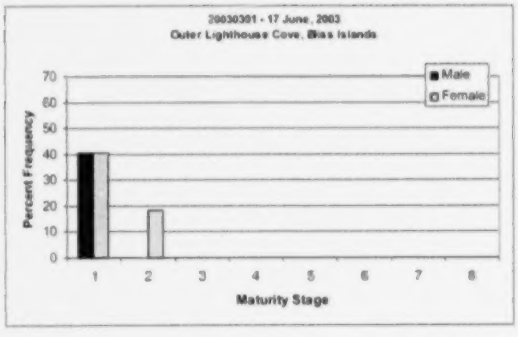
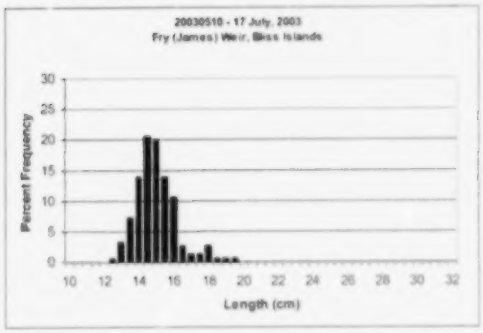
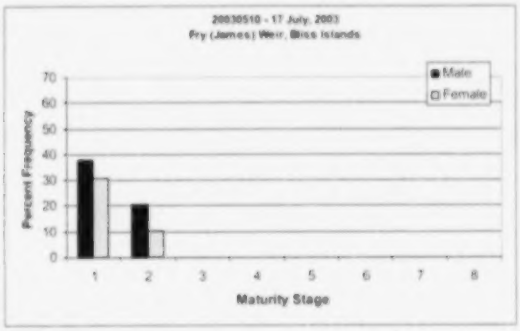
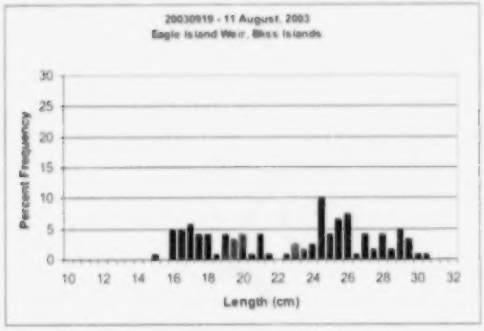
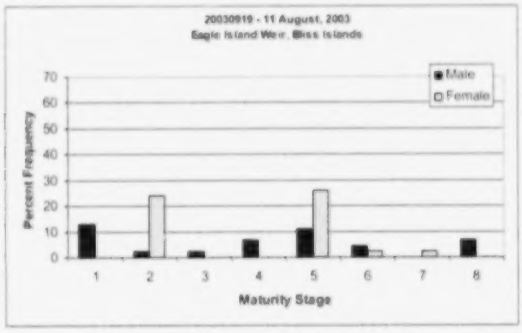


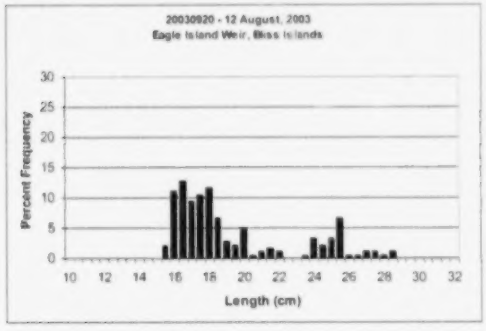
Figure 2a: Bliss Islands tagging samples.

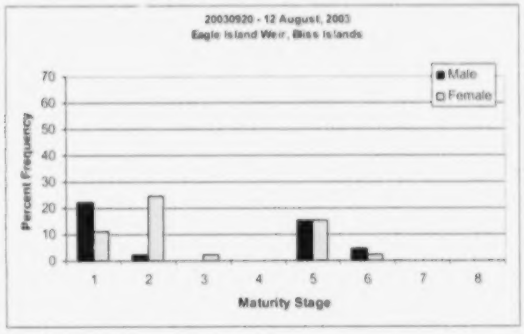












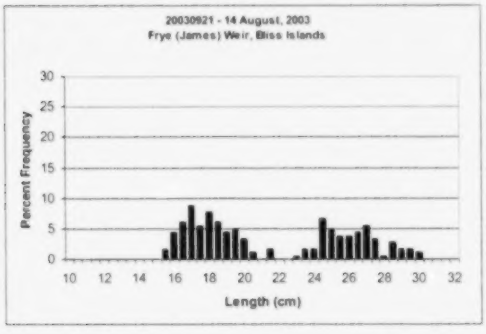
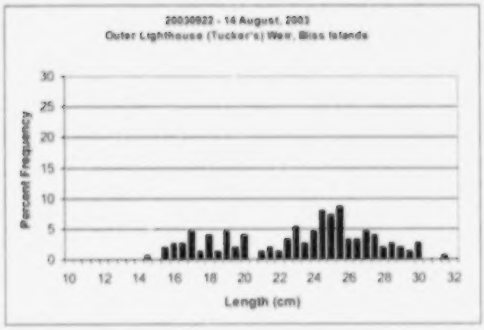
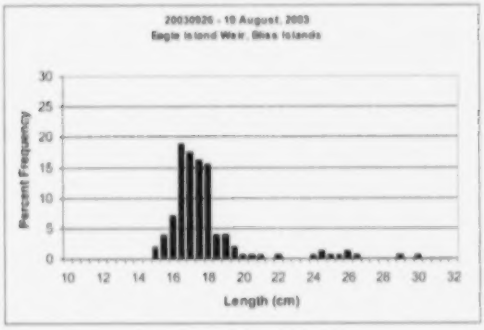
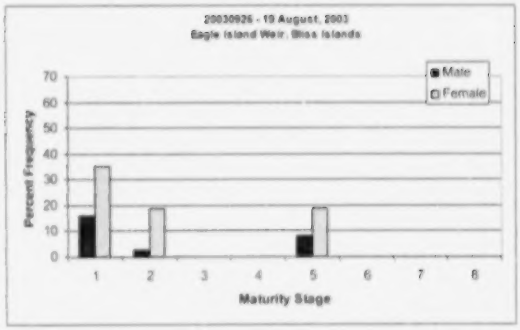
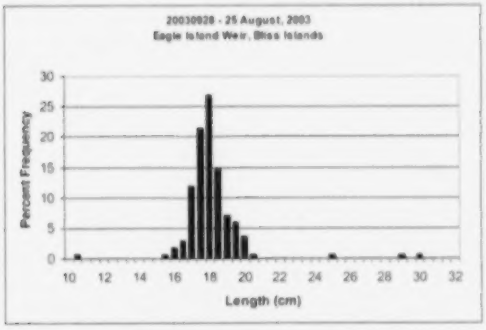


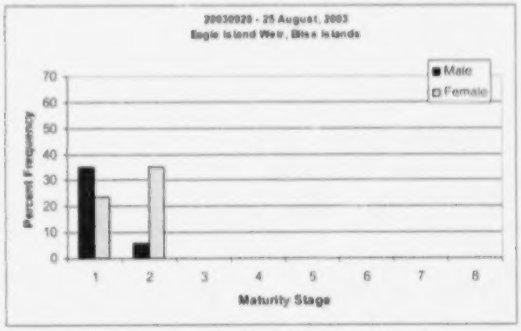
Figure 2b: Bliss Islands tagging samples continued. No maturity data were available for August 14, 2003.

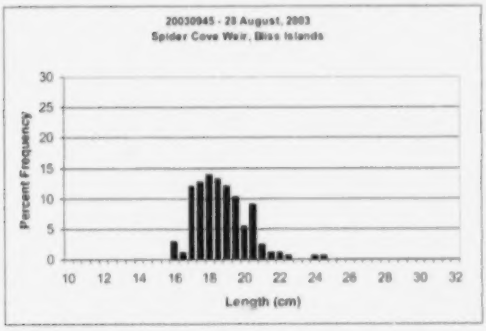












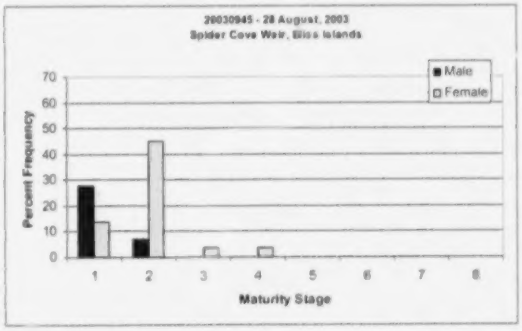


Figure 2c: Bliss Islands tagging samples continued. No maturity data were available for August 14, 2003.

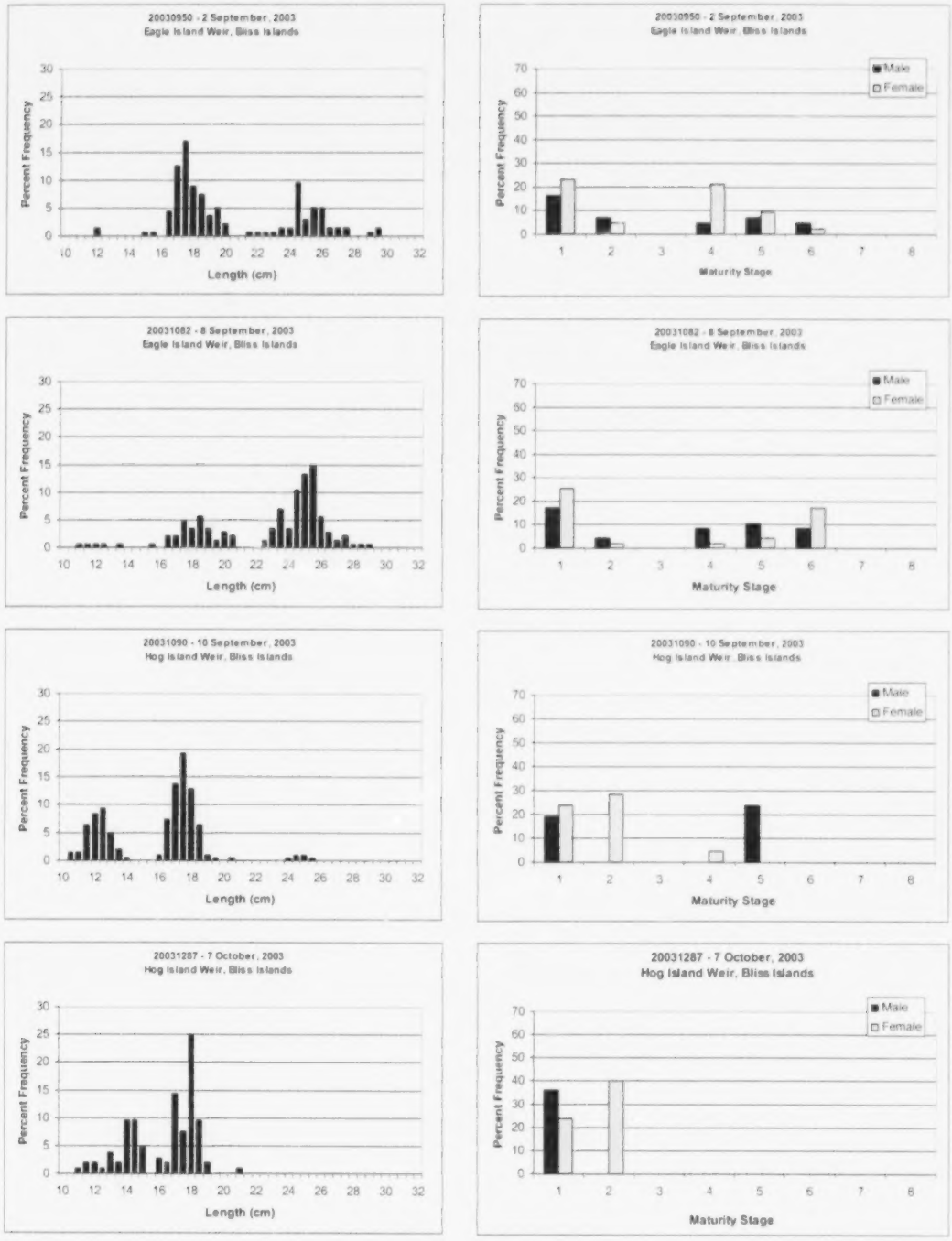


Figure 2d: Bliss Islands tagging samples continued.

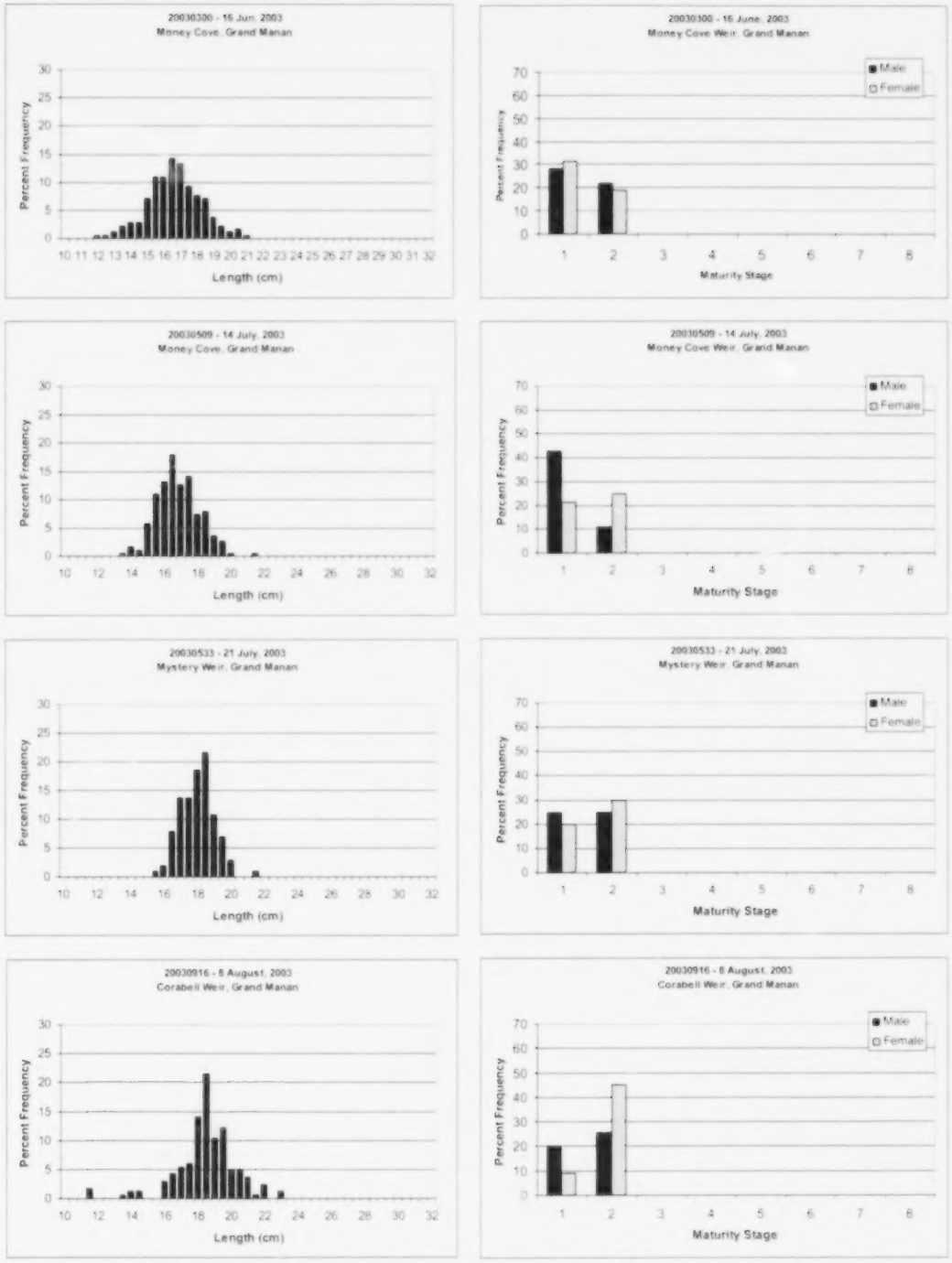


Figure 3a: Grand Manan tagging samples.

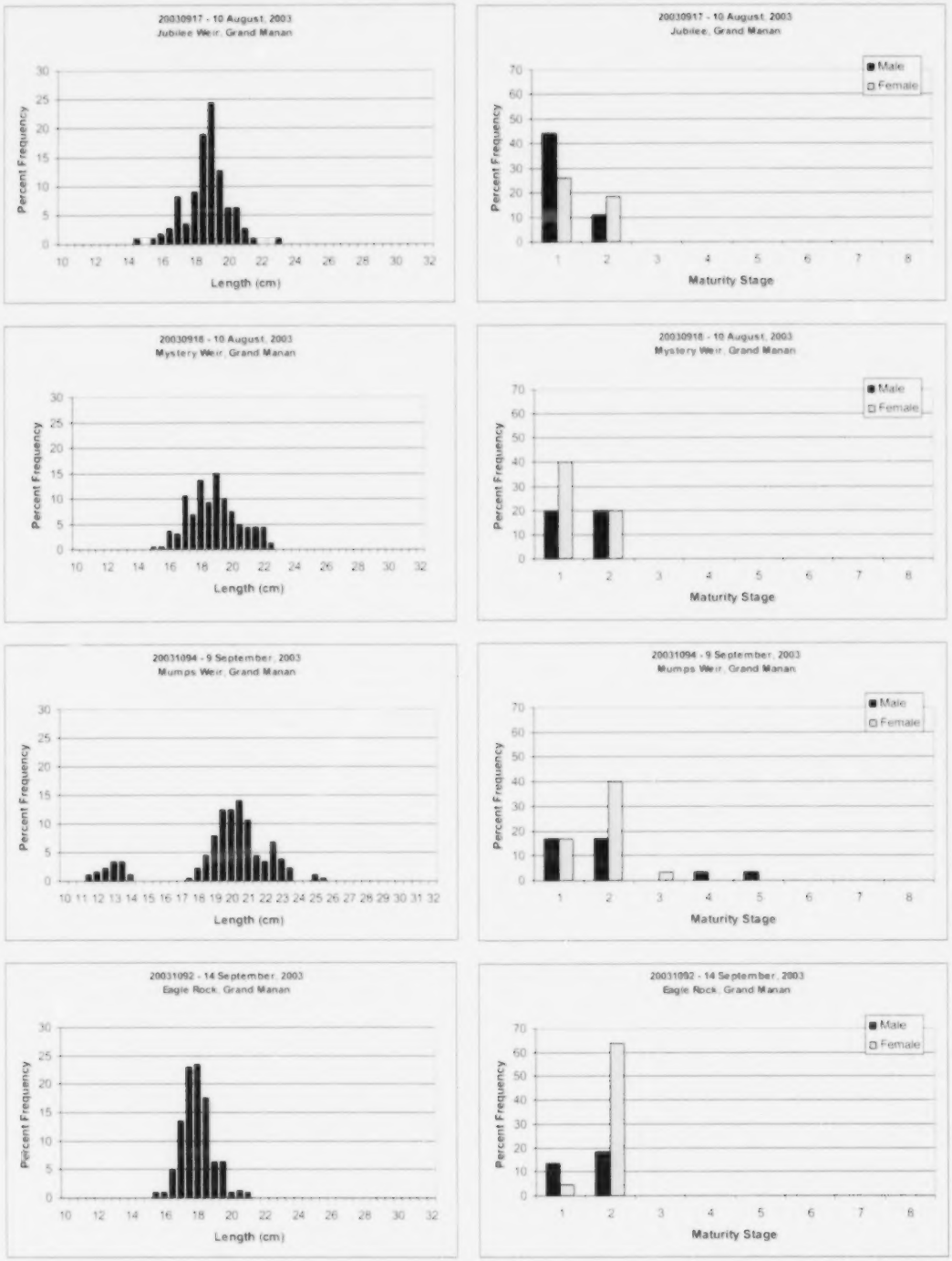


Figure 3b: Grand Manan tagging samples continued.

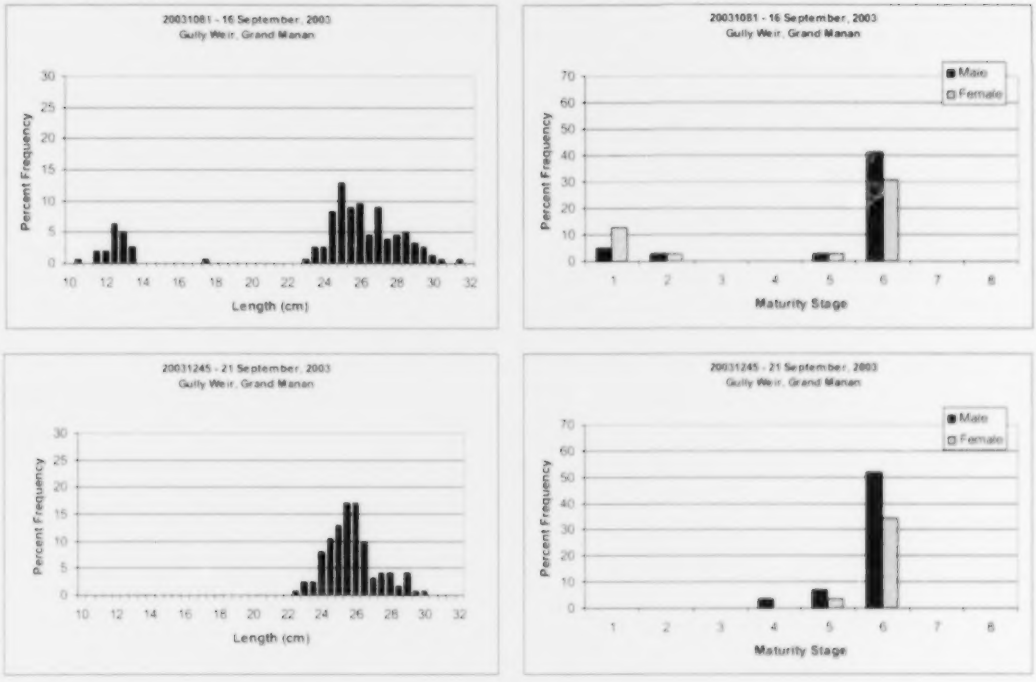


Figure 3c: Grand Manan tagging samples continued.

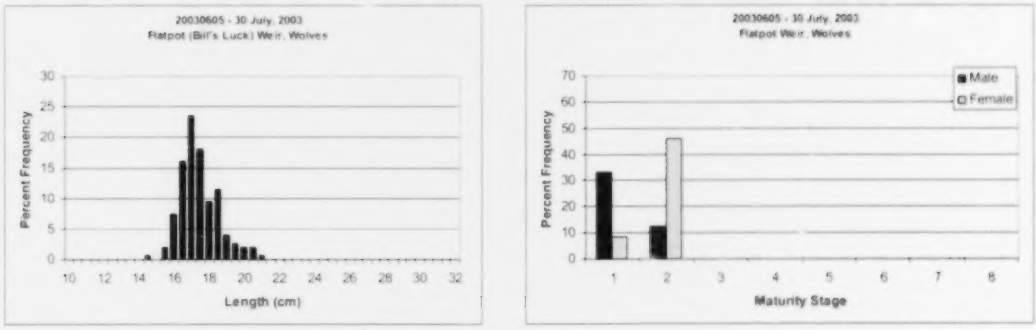
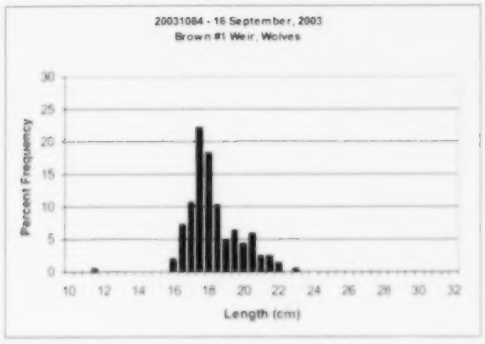
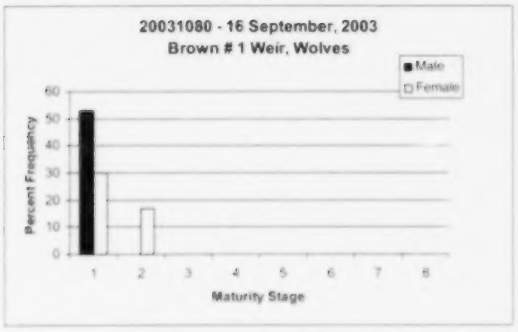
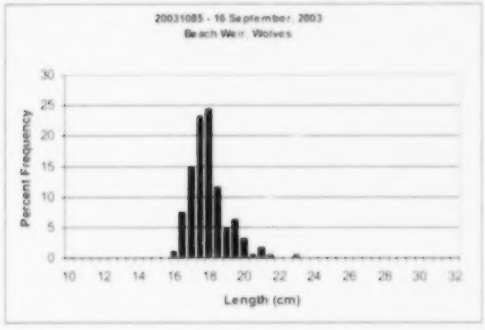
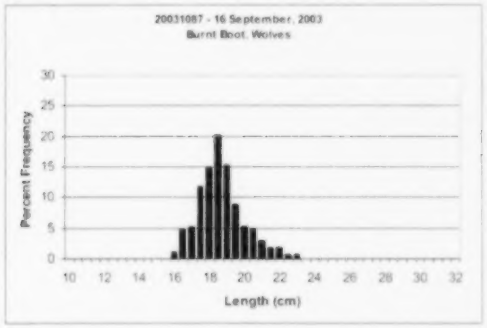


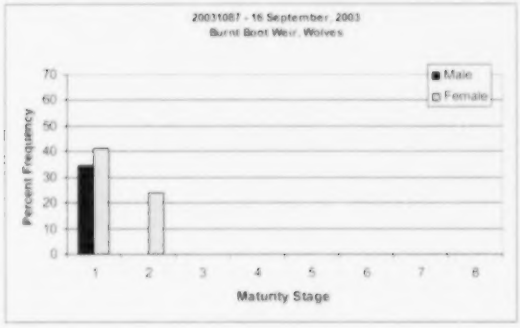
Figure 4a: Wolves Islands tagging samples.

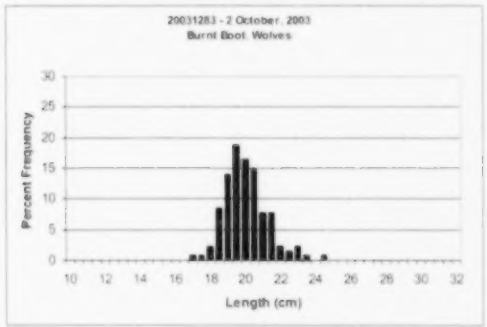












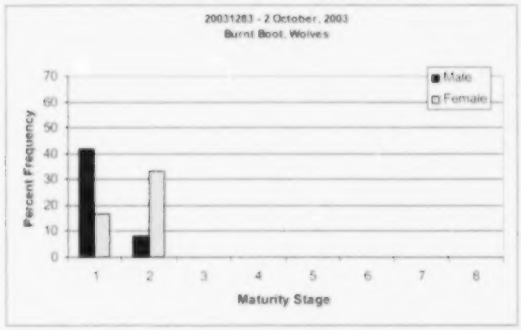
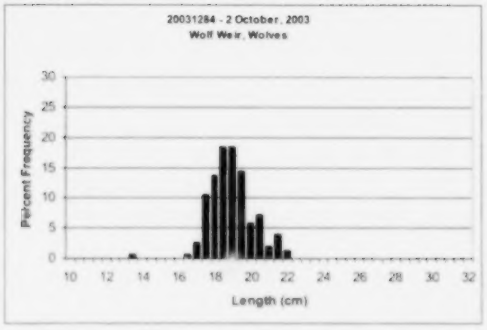
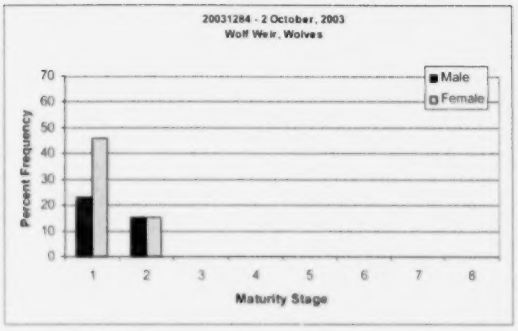
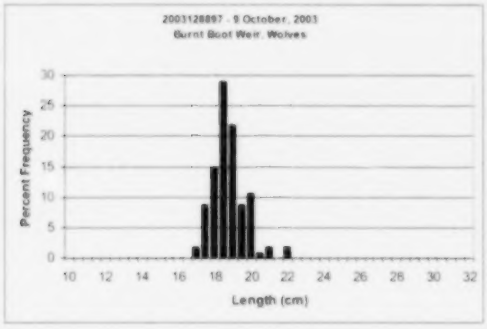


Figure 4b: Wolves Islands tagging samples continued. No maturity data were available for sample 20031085 from September 16, 2003.







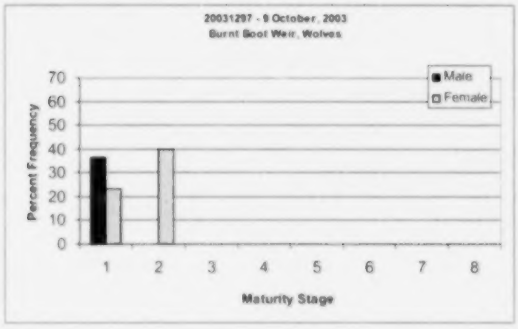
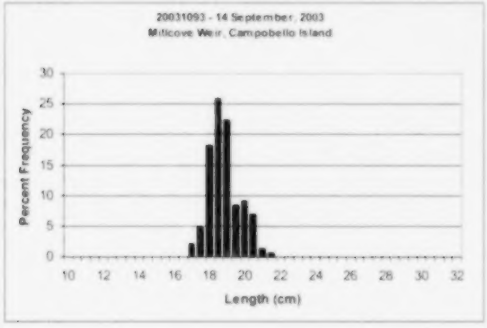


Figure 4c: Wolves Islands tagging samples continued.



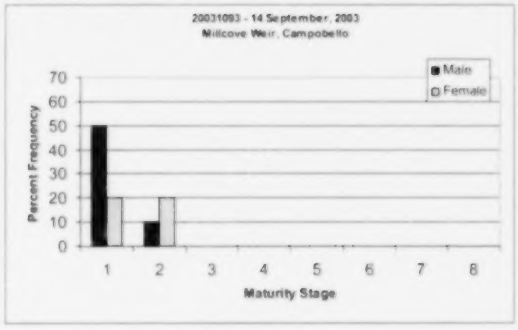


Figure 5: Campobello tagging sample.

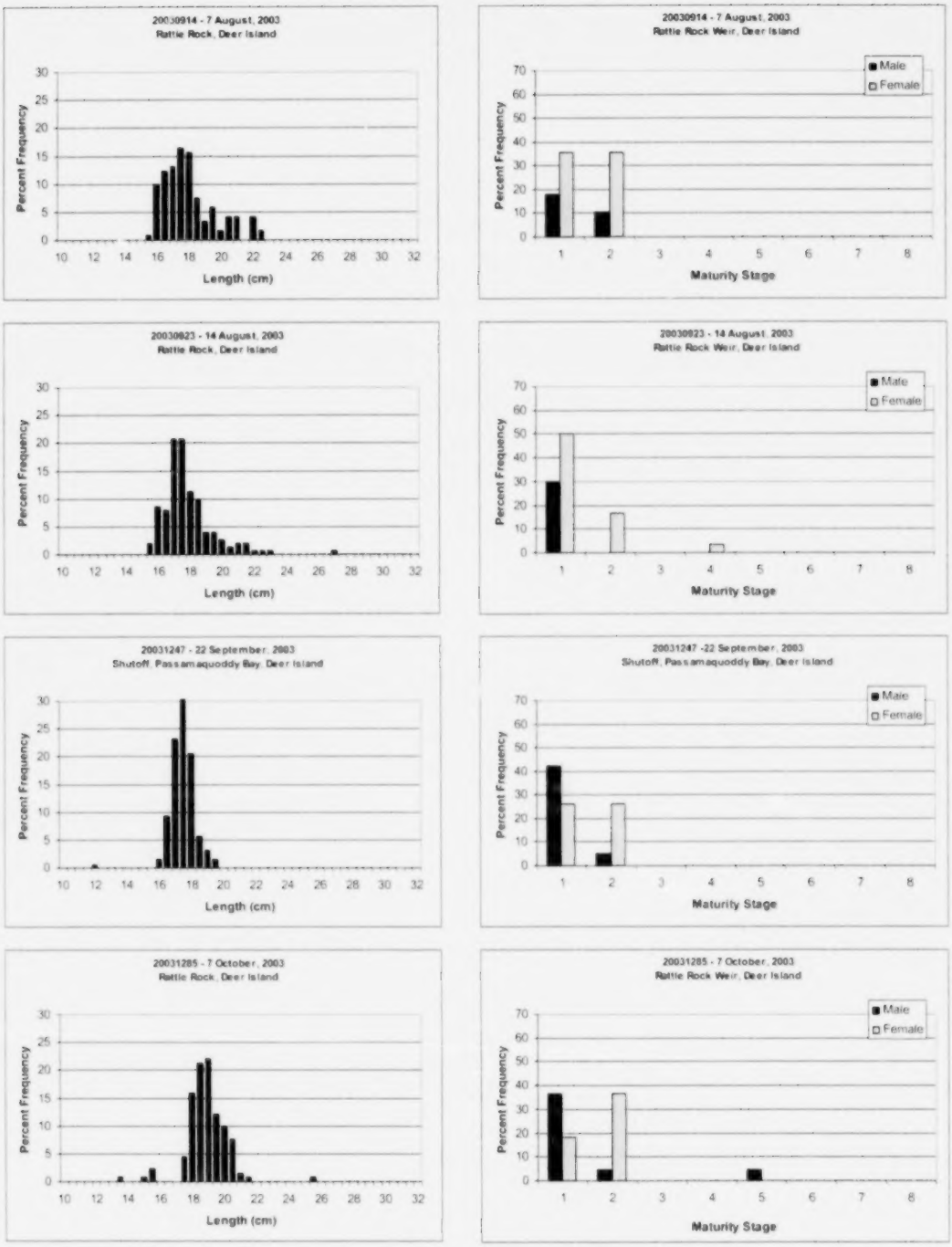


Figure 6: Deer Island tagging samples.

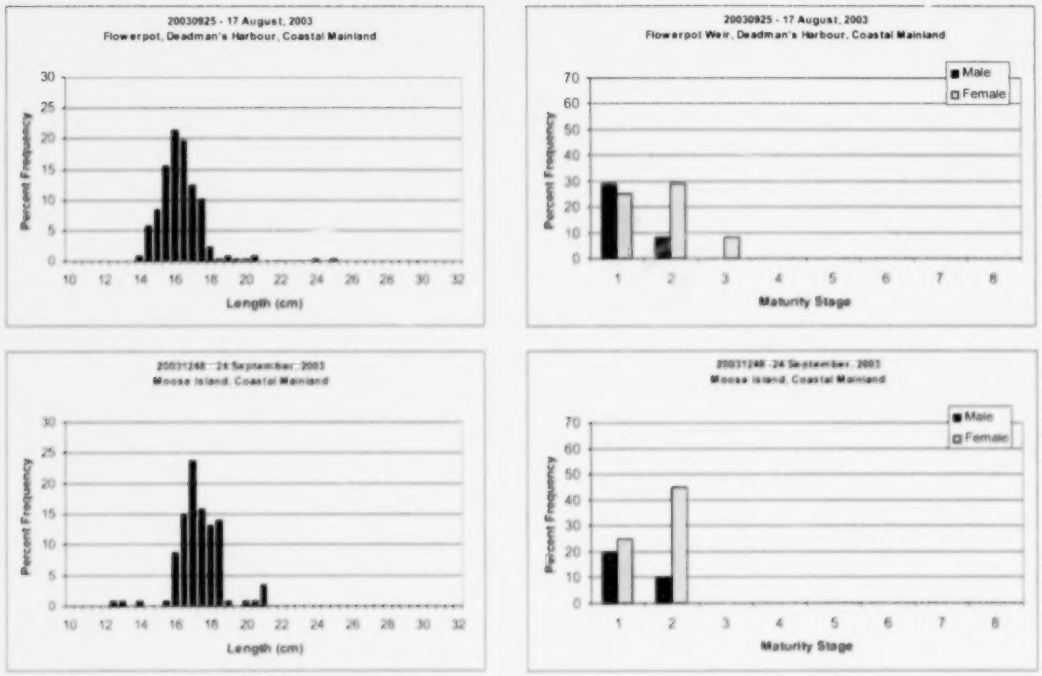


Figure 7: Coastal Mainland NB tagging samples.